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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SECTION K—PHYSIOLOGY AND EXPERIMENTAL MEDICINE.

EXECUTIVE PROCEEDINGS.

OFFICERS elected for 1906–1907:

Vice-president and Chairman of the Section—Simon Flexner.

Secretary—William J. Gies.

Member of Council—Alexander C. Abbott.

Sectional Committee—W. T. Sedgwick, vice-president, 1905–'06; Simon Flexner, vice-president, 1906–'07; William J. Gies, secretary, 1905–'07; Frank Baker (one year), C. S. Minot (two years), J. McK. Cattell (three years), Ludvig Hektoen (four years), Graham Lusk (five years).

Member of General Committee—James Carroll.

SCIENTIFIC PROCEEDINGS.

Morning Session.

Vice-presidential Address—*The Experimental Method in Sanitary Science and Sanitary Administration:* WILLIAM T. SEDGWICK. (Presented by A. L. Metz.)

Symposium on Yellow Fever and other Insect-borne Diseases.

Introductory remarks by the acting chairman, Alexander C. Abbott.

GARY N. CALKINS: 'The Protozoon Life Cycle.'

HENRY B. WARD: 'Filariasis and Trypanosome Diseases.'

J. H. WHITE: 'The Practical Results of Reed's Findings on Yellow Fever Transmission.'

Afternoon Session.

QUITMAN KOHNKE: 'Difficulties of Recognition and Prevention of Yellow Fever.'

Henry Clay Weeks: 'The Practical Side of Mosquito Extermination.' (Presented by A. C. Eustis.)

James Carroll: 'Without Mosquitoes there can be no Yellow Fever.'

H. A. Veazie: 'Æstivo-autumnal Fever—Cause, Diagnosis, Treatment and Destruction of Mosquitoes which spread the Disease.'

Discussions of the various papers by Messrs. James Carroll, G. N. Calkins, L. O. Howard, J. H. White, S. E. Chaillé, A. C. Abbott, A. L. Metz, H. B. Ward, Quitman Kohnke, A. C. Eustis and others.

Wm. J. Gies,
Secretary.

THE EXPERIMENTAL METHOD IN SANITARY SCIENCE AND SANITARY ADMINISTRATION.[1]

The value of experimentation in all branches of inquiry is now generally recognized; its philosophical significance and its limitations are less often understood and appreciated. In the present paper I propose to show that there is no hard-and-fast line between the results of experiment and those of experience, and that in the field of sanitation, in which of necessity laboratory experiment is difficult when not impossible, the data of experience carefully studied and rigidly verified are capable of yielding results no less valuable than those derived in some other subjects by experiment.

To avoid confusion let us understand clearly at the outset exactly what we mean by the terms *experiment, experience* and *observation.* Originally signifying much the same thing as experience, namely, both the processes and the results of trial or test, the word *experiment* has in recent times come to be used chiefly for a prearrangement, and an artificial arrangement, of conditions in such a way that specific questions shall be answered; while the term experience has come to be used most often to describe a result rather than a process—a result, moreover, obtained without prearrangement, and under natural or unpremeditated, rather than artificial or premeditated, conditions. We speak, for example, of an *experiment* upon the strength of materials and an *experience* with a broken rail, or railway bridge. The term *observation* requires no special comment. Without this, both scientific experiments and scientific experience are worthless. *Verification* is, of course, the checking, controlling or testing of the data and results of experiments or experiences, in order to determine their accuracy or degree of truth; and we are still indebted to George Henry Lewes for his striking exposition of the fundamental and indispensable function of verification in all sound and scientific inquiry.

Now a little reflection will show that experiment, in the somewhat narrow sense here laid down, is necessarily comparatively limited, and very likely to be confined largely to the laboratory, for the reason that any prearrangement of conditions which shall be actual tests or trials of natural phenomena must oftenest be made under cover, in limited space, with comparatively few objects, and at comparatively small cost. Hence it has come to pass that the experimental sciences have been chiefly those which could be advantageously pursued in laboratories and workshops, and upon the small, rather than the large, scale. There can be little doubt that this fact has tended to magnify the importance of subjects or parts of subjects lending themselves readily to laboratory experimentation, and has served to draw off attention from, and thus to hinder, the development of other sciences, or portions of sciences, quite as important as those capable of advancement by laboratory experimentation. In physics, for example, we may well suspect that materials at hand, such as air or water,

[1] Address of the vice-president and chairman of Section K, American Association for the Advancement of Science, New Orleans, December, 1905.

and problems at hand, such as the behavior of bodies at various moderate temperatures, have received more study than their intrinsic importance requires, while remoter objects such as the heavenly bodies, and very high and low temperatures have not received the attention which they deserve. Doubtless the same fact holds in the biological sciences, including physiology and medicine. Experiments upon the physiological action of drugs have probably received, especially in the past, relatively too much attention, because of the ease with which they could be carried out; while the more difficult and more costly experiments, for example those required to determine the purity of large bodies of water, such as rivers and lakes, or those upon the purification of sewage, have until recently received but little attention.

There is danger, moreover, that in the instinctive recognition of the difficulties of laboratory experiments upon large and difficult problems, investigators shall turn aside from the careful study and verification of the data and results of another class of experiments which, for the sake of differentiation, we may call natural rather than artificial experiments, and which in everyday language are described as experience. It is, for example, obviously unwise to regret our inability to test by the methods of ordinary artificial experiment the effects of polluted drinking water upon large communities, when there are frequently being exhibited, all about us, by such communities, natural experiments on a grand scale, the conditions of which can often be accurately determined, even after the fact, and the results of which are as capable of verification as are those of artificial experiments prearranged to answer specific questions.

When, in 1893, the city of Lawrence, Mass.—long in the habit of drinking the unpurified water of the polluted Merrimac River, into which only nine miles above the intake of the Lawrence waterworks the raw sewage of the city of Lowell was poured—set up between that water and its citizens a barrier of defense (a sand filter) permeable by water but impermeable by disease germs, an experiment was undertaken under conditions quite as clear and as favorable as those under which many laboratory experiments are conducted. The data at hand concerning this experiment—concerning its cause, inception, conduct and consequences, were such as to enable those having the opportunity to study it to reach results, and to draw conclusions, of high accuracy, and even to predict with confidence the consequences of similar experiments elsewhere. This experience of a modern American municipality was also an experiment in the narrower sense—although not a laboratory experiment; for it was made artificially, and by prearrangement, in order to solve a specific problem, namely, to get rid of typhoid fever in a community in which that disease had long been, in the old phraseology, 'endemic.'

One experiment often leads to another, and so also an experience often leads to an experiment. Years before, in 1872, acting under the best engineering and scientific advice of the time, the city of Lawrence had introduced for the benefit of its citizens a public water-supply drawn directly from the Merrimac River nine miles below the mouths of the sewers of Lowell, as already stated above. In doing this there was no thought of making any scientific or sanitary experiment, but only of supplying the city with water for fire purposes and domestic convenience. Unwittingly, however, an important experiment was really being made by that municipality. As surely as if by premeditation and prearrangement a trial was being made, day by day, and year by year, of the effect upon the public health of the city of the use of a

water-supply polluted with human excrements; and when, in 1890, typhoid fever appeared among the citizens to such an extent as to constitute a terrible epidemic, and to cause careful observation and study of the past as well as the present, it became evident that a most important experiment had been going on ever since 1872—quietly, naturally and unobserved—and an experiment not merely dire in its consequences, but rich in its sanitary teachings.

Careful studies of the various phases of this long-continued and tragically-ending experiment showed that the citizens of Lawrence had submitted themselves to, and participated in, conditions such as no premeditating experimenter in his wildest flights of fancy would have dreamed of proposing; for they had, for twenty years, been drinking the diluted excrements and other wastes of a large and dirty city. Further studies revealed the fact that so long as these excrements were unmixed with those of typhoid fever patients no excess of typhoid fever ordinarily appeared in Lawrence, but that if typhoid fever abounded in Lowell then, after the lapse of a period of time such as would be required for its transmission to the citizens of Lawrence, and for its usual incubation, typhoid fever invariably appeared in the lower city. In the end, this unpremeditated experiment proved to be remarkably instructive, for while Lawrence and Lowell were thus unconsciously experimenting, Haverhill, on the same river a few miles below, and Nashua, a few miles above, experimenting with relatively pure water supplies, suffered no excess of typhoid fever. These facts threw great light upon the cause of a constant excess of typhoid fever long characteristic of Lowell, and calmly accepted by the local physicians and sanitary officials as 'endemic'—whatever that might mean—and regarded by them as unavoidable. For when the opportunity came to test their theory by a premeditated experiment, namely, the purification of the water, this 'endemicity' of typhoid fever in Lawrence disappeared. It then became clear that the so-called 'endemic' was really an epidemic condition; an epidemic condition characterized by the constant existence of a moderate number of cases, rather than the occasional existence of a great number, *i. e.*, by constancy, rather than magnitude.

These simple facts will serve quite as well as any more extended discussion to establish the fact which I desire especially to emphasize in this paper, namely, that the experimental method is not necessarily confined to laboratories, or applicable only to individuals. Some of its best examples, and some of its richest fruits, may be found in sanitation, as well as in physiology or hygiene; in the environment, as well as in the individual.[2]

The practical importance of the recognition of these facts is very great. Comparatively few physicians or sanitarians are in a position to conduct artificial experiments of great importance, whether inside or outside the laboratory, but almost any wide-awake observer, whether he be physician, physiologist, sanitarian or engineer, may, if he will, find going on all about him natural experiments, the conditions of which may often be learned with great accuracy even after the experiment

[2] The author believes that a natural and serviceable distinction may be drawn between hygiene and sanitation, the former term being kept for those aspects of general hygiene, or the public health, affecting chiefly individuals or groups of individuals, the latter for those affecting chiefly environments. He has used this distinction with advantage for some two or three years past in his teaching and in his writing, *e. g.*, in the *Encyclopedia Americana*, Vol. XIV., article 'Sanitary Science and Public Health,' New York, 1904, and in a paper, 'The Readjustment of Education and Research in Hygiene and Sanitation,' in the forthcoming volume of *Proceedings* of the American Public Health Association.

is completed, and which may yield conclusions quite as capable of verification as are those of experiments made in the laboratory. This should be a matter of no small encouragement, especially for younger workers who, wherever they are, and whatever they may be doing, may safely rest assured that if they will bring to bear upon the experiments which nature is making all about them the same careful observation, generalization and verification which they would apply to laboratory experiments, they are no less likely to reach results of the highest consequence, as well as to win the cordial appreciation of all competent scientists.

Many communities, moreover, are nowadays embarking upon new phases of water supply, sewerage, and sewage-disposal which, rightly considered, constitute veritable experiments in sanitary science and sanitary administration. And one of the most encouraging signs of the sanitary times is the custom, now universally approved and already widely adopted, of instituting elaborate and often extensive experiments, before embarking upon costly and far-reaching improvements, the outcome of which would otherwise be doubtful or uncertain. The establishment by the State Board of Health of Massachusetts in 1886 of a sanitary research laboratory and water and sewage experiment station, on the shore of the Merrimac River, in Lawrence, marked the beginning of a new and important era in practical sanitation, because it was the introduction of the experimental method into a field of human activity in which hitherto the results of natural experiments had been the only guide. Imbued with the scientific spirit, and convinced of the importance of the experimental method in sanitary science, as demonstrated at the Lawrence Experiment Station, where they were among the earliest workers, Messrs. Allen Hazen and George W. Fuller, now sanitary engineers of the first rank, caused the same methods to be invoked and applied before embarking upon the actual purification of the water supplies of Pittsburgh, Albany, Louisville, Cincinnati and other cities, with which they have had to deal. Still more recently, Mr. Fuller has planned and conducted, at an expense of $50,000 or more, a series of elaborate experiments in order to determine the best methods for the purification of the sewage of the city of Columbus, Ohio. The results of all these experiments are everywhere conceded to have been so valuable and instructive that well-advised municipalities to-day rightly hesitate to embark upon large and costly schemes of sanitation without first having made extensive experiments, locally conducted, bearing upon the solution of their own peculiar problems. It has been learned, moreover, by both experiment and experience, that the terms 'water' and 'sewage' which have so long been used in the abstract in sanitary science, when applied to concrete natural waters, and municipal or manufacturing wastes, ought rather to be made plural, for the reason that the waters of various parts of the country, and the sewages of different communities, differ so widely, one from another, as to require widely different methods for their successful treatment.

In other forms of sanitary practise also, such as the drainage of marshes, the petrolizing of ponds or stocking them with fish, the experimental method has been usefully employed. Experiments upon the improvement of cows and cow-stables have given good results in cleaner and more normal milk. Experiments in street cleaning have shown that dirty streets are an evil, but not a necessary evil. Experiments in the separation and utilization of wastes have yielded results of sanitary and financial importance. Experiments like that of the city of Munich on the effect of sewerage upon

the public health; experiments upon the cost and importance of systems of heating and ventilation; experiments upon the efficiency of copper sulphate as an algicide; experiments on the influence of pasteurized milk upon infant mortality—all these, and many more that might be given, testify to the value of the experimental method in sanitation. And yet, in most cases of this kind, we have to say, as Adams said of political experiments, 'these can not be made in a laboratory or determined in a few hours.'

There remains, however, one department of sanitation, viz., that of sanitary administration, in which the results of experience are more abundant than those of experimentation, results, too, which can not be regarded with either pride or satisfaction. I refer to the constitution and sanitary work of our various state and local boards of health. In some few cases these boards are well constituted, courageous, intelligent and efficient. In a few cases they are even famous for their good work. In some other cases, although themselves incompetent, boards of health have had the good sense, or good fortune, to employ as their agents real experts, and to delegate to these their sanitary work. But experience shows that some state boards, and many local boards, of health, in the United States, are badly constituted, inefficient if not ignorant, and cowardly. The experiment has now been fully tried of appointing to such boards mere place-seekers and incompetents, with the natural results of poor public service and dangerous neglect of the sanitary interests of the people. It requires some knowledge, skill, courage and wisdom, to administer the sanitary affairs of a modern community, and few indeed are the American cities or towns which have made the experiment of organizing their boards or commissions of health to meet these requirements. Too often a hack politician or two, a second-rate doctor or two, and one or more vain or place-seeking nobodies —useless but not harmless—make up our local boards of health; and as no stream can rise higher than its source the services of such boards are disgracefully small in quantity and poor in quality. It requires no further use of the experimental method, to predict from such direction or control of sanitary affairs, in further trials, dismal consequences.

Worst of all, this foolish and almost criminal experimenting is going on while we have to-day in America opportunities for some of the most interesting sanitary experiments that any scientist could desire. We are establishing model dairies, model municipal water filters, model sewage and garbage disposal-plants. Why can we not also experiment with a few model boards of health, which shall boldly set to work, and themselves make the experiment of trying to give to the city or town under their care the best possible sanitary (and I may add hygienic) conditions? Why can we not have more boards constituted, like that of Montclair, N. J., of one or more leading physicians, one or more good civil engineers, one or more good lawyers or business men? Why can we not have more boards experimenting upon the control of milk supplies, as are to-day the boards of Montclair, of New York and of Boston? More boards studying experimentally the conditions required to secure proper heating and ventilation of public halls and public conveyances? More boards experimenting upon the suppression of the smoke nuisance, the dust nuisance, the noise nuisance? It is of comparatively little use to make good laws if no one will enforce or obey them, and improved methods of sanitation (and hygiene) are of small value unless intelligent, courageous and energetic boards of health adopt and enforce them.

In Massachusetts the district medical ex-

aminer has displaced, with great advantage to all concerned, the aforetime local coroner. And if, as there is much reason to suspect, local influences and prejudices make it almost everywhere difficult to secure able and aggressive local boards of health, then the experiment should be tried of having district, county or state officials, authorized and willing to do the necessary sanitary work. The present plan is a failure experimentally demonstrated; let us continue to invoke the experimental method, in which we believe, but abandoning our present customs, which have been experimentally proved—for the thousandth time—to be hopeless, and trying something more promising. We can not do much worse; we ought to do much better.

WILLIAM T. SEDGWICK.
MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

SYMPOSIUM ON YELLOW FEVER AND OTHER INSECT-BORNE DISEASES.

The Protozoon Life-Cycle: GARY N. CALKINS.

The wonderfully successful results obtained in New Orleans in the struggle against *Stegomyia fasciata* has shown that in yellow fever, as was long the case in smallpox, protective measures may be understood and applied, although the specific cause of the disease is unknown.

I do not intend to discuss the question as to whether this specific cause is a bacillus or a protozoon, nor to consider the various organisms that have been found in infected yellow-fever mosquitoes. I purpose, rather, to speak upon some of the general biological phenomena distinctive of protozoa, and of the variations in vitality at different periods of the life-cycle, and then to point out in how far the present data regarding the yellow-fever organism agree with these established facts.

The protozoa are minute animals, consisting for the most part of single cells having an independent life. They vary in size from minute forms, too small to be seen with the highest powers of our modern microscopes, to giant forms from two to three inches in diameter. The vast majority thrive in seas and lakes, stagnant pools and ditches, and are absolutely harmless to man; indeed, they become a boon to him by giving to thousands of microscopists the materials for a fascinating pastime. A small minority are parasitic, but these few cause vast epidemics among silkworms, fish, and domestic animals, and have been the means of great economic loss, or, through malignant human epidemics, have terrorized whole communities and have brought about untold loss of life.

A protozoon rarely retains its individuality more than a few hours. It then divides into two, or, in some cases, into a larger number of daughter individuals. The parent organism has not died, there is no unicellular corpse, but the protoplasm of which that organism was composed is now distributed by division among two or more individuals. The process is repeated again and again, and thus it continues, a repetition of growth and reproduction. We can not speak, therefore, of the life-cycle of an individual protozoon, but must consider rather the protoplasm of which that individual is composed. It is this protoplasm that goes on through generation after generation of individuals, and through all the phases that constitute the aggregate of phenomena which has been termed the life-cycle.

It was formerly believed that this protoplasm, having all of the necessary functions required for an indefinitely continued existence, gives to the protozoon the attribute of an endless life—physical immortality. Experiments made within comparatively recent times have shown, however, that this is not true and that the protoplasm of a given protozoon gradually loses its

vitality with continued division or asexual reproduction, until it ultimately dies of old age no less surely than does the protoplasm that makes up the tissues and organs of higher animals. It is known that a protozoon immediately after conjugation with another of its own kind, a process which agrees in essentials with the fertilization of an egg by a spermatozoon, has a high potential of vitality which enables it to live and multiply asexually for a long period, with, however, a gradually decreasing vitality which, unless renewed by conjugation, ultimately gives out, the protoplasm dying of old age. Conjugation, then, appears to be a process of rejuvenescence and has been so interpreted since the classical experiments of Maupas in 1888 and 1889.

In every protozoon life-cycle, in free living and parasitic forms, we can make out, with more or less precision, three phases which correspond with analogous phases in the life of a metazoon. The vigorous, actively dividing forms are found in the period immediately after conjugation and this period corresponds with the period of youth. The conjugating period, or the time when the protoplasm is capable of renewing its vitality by conjugation, corresponds with the period of adolescence, or maturity, and, in the forms which have not conjugated, the period of increasing degeneration and old age compares with the old age of metazoa.

The study of many types of protozoa has shown that with decreasing vitality there are frequently marked changes in the form of the body and in the physical composition of the protoplasm. These changes are most marked at the period of sexual maturity, when they frequently give rise to structural modifications as widely different as the egg and the spermatozoon. It is while in this condition of the protoplasm that sexual union take place and, through this, renewal of vitality and return to the type form. This condition of the protoplasm, which indicates a modification of the physical organization of the protozoa at periods of adolescence, comes sooner or later in the history of any life-cycle, but it can also be induced artificially in many cases. Thus it has been possible to change ordinary asexual flagellated protozoa into sexual forms by increasing the density of the surrounding medium through addition of sugar, etc.; or by lowering the temperature, perhaps again, a matter of density. In a number of parasitic forms, some of which affect the welfare of human beings, a similar change in environment is a normal part of the life-cycle, and is brought about by insects, sometimes mosquitoes, sometimes ticks and sometimes flies. The asexual protozoon organisms are transferred from the warm blood of birds or mammals, or man, to the cold environment of the insects' digestive tract. This is accomplished in the case of malaria by mosquitoes belonging to the genus *Anopheles;* in the case of bird malaria by mosquitoes belonging to the genus *Culex;* in the case of sleeping sickness by the tsetse-fly; in the case of Texas fever among cattle by ticks belonging to the genus *Boophilus.* Where the full life history has been made out, it has been found that conjugation takes place within the body of the insect and here, therefore, vitality of the parasite is restored.

What is known to take place in some of these well-authenticated cases is presumably true in the case of yellow fever. The blood with the organisms in it is taken into the digestive tract of the mosquito (*Stegomyia fasciata*), and here, or in some other organ, the germ probably passes through some developmental cycle, for a period of twelve days is necessary before such infected mosquitoes can transmit the disease to another human being. The similarity to the malaria organisms in the

period of incubation, as well as in the change of hosts, is a striking argument in favor of the protozoon nature of the yellow-fever germ.

The different forms which protozoa assume at various periods of the life-cycle have been frequently mistaken for different species or different genera, and well-known cases such as *Plasmodium* and *Polymitus*, or *Coccidium* and *Eimeria*, where the different phases were regarded for a long time as distinct types of organisms, justify the view that the entire life-cycle should be taken into consideration when describing species. The changes in form at the different periods are due, as I believe, to the differences in vitality.

[Here a number of lantern slides were shown illustrating the variations in structure, etc., in various types of protozoa.]

In *Tetramitus* the free-living asexual forms have a definite membrane and a definite body form and continue to multiply by simple division for a period of two or three days, when the definite membrane becomes plastic and the body assumes more or less amœboid forms resembling the genus Mastigamœba. In this condition of the protoplasm two individuals upon coming together fuse into a common mass, their nuclei unite and conjugation is effected. After conjugation a firm cyst is secreted within which the protoplasm divides into hundreds of parts, which escape from the cyst, finally, as young flagellates.

In *Polystomella* the polymorphism is shown by two types of shell and by different forms of the young organisms. In the microsphæric type there is a characteristic fragmentation of the nuclei into many chromatin particles of small size. This is followed by formation of amœboid spores, which develop into shelled forms of a different type from the first (macrosphæric), and these in turn give rise to flagellated spores which conjugate.

The decrease in vitality can be measured in a rough way and the relative vitality at different periods can be easily compared. This has been done in the case of some of the free living infusoria, for example in *Paramœcium, Oxytricha,* etc. For such comparisons a single individual is isolated and within twenty-four hours it divides. The daughter cells are similarly isolated, and this process is repeated until the protoplasm under observation dies from exhaustion of vitality, in one case (*Paramœcium*) after twenty-three months of observation, during which time 742 divisions were recorded. When averaged for ten-day periods these divisions gave a satisfactory measure of the vitality at different times during the cycle. It was found in these experiments on *Paramœcium* that after about 200 generations the vitality is apparently exhausted, but that it can be restored by artificial means and stimulated to a new cycle of about 200 generations. Ultimately, however, artificial stimuli failed to renew the vitality and the race died out in the 742d generation. Such artificial stimulation suggests the possibility that in certain human diseases, such as malaria, the organisms may become exhausted so far as the division energy is concerned, but may remain quiescent in the system, hibernating, as it were, in some organ until, owing to some change in the chemical composition of the blood, an artificial stimulus renews the division energy and a recurrence follows.

Turning now to the data that have accumulated in regard to the organism of yellow fever, we must note that the rapid development in the blood indicates a high potential of vitality; that the disappearance from the blood indicates that the organisms have been killed off through excess of their own toxins, or by accumulation and action of the anti-bodies. The long period of incubation in the mosquito

indicates that processes are taking place in the development of the germ which can be explained only on the supposition that conjugation phenomena, analogous to those in the malaria mosquito, are taking place, and this supports the view that in the human blood the organisms are endowed with a high potential of vitality. Again, the filtration experiments in which it has been demonstrated that the organisms may pass through the finest filters known to us, indicate that the organism is among the smallest of living things, and belongs to that group which is rapidly becoming more than hypothetical, the ultra-microscopic forms. The small size may be a result of rapid multiplication, and it is not improbable that after the incubation period larger forms will be recognized in the digestive tract of the mosquito and in the salivary glands.

Finally, if the organism is a protozoon there is only a limited possibility as to its systematic position. Larger forms like *Trypanosoma* would not pass the finest filters; corpuscular parasites like *Piroplasma* would likewise be filtered out, besides which the yellow-fever organism is known to be a plasma parasite. A single genus of protozoa is known at the present time that fulfills all of the conditions of the yellow-fever organism; amongst its species are some that are at times ultra-microscopic; that have a characteristic change of hosts from warm-blooded forms to mosquitoes and that are characterized by remarkable virulence. This is the genus *Spirochæta* and in it alone, at the present time, do we find the type that satisfies all of the conditions known of the organism of yellow fever.

Dr. James Carroll said in discussing Professor Calkins's paper: "I have listened with the greatest interest to Professor Calkins's exposition of the life histories of protozoa and I am reminded by it of a series of hypothetical experiments that for some time I have felt a great desire to see performed and which might throw a flood of light on the nature of the parasite of yellow fever. Reasoning from the standpoint that the organism is an obligate animal parasite, a series of passages through the human being by means of direct inoculations with blood, without the intervention of the mosquito, should gradually bring about attenuation or eventually render it incapable of further reproduction in man, by restricting its existence to a single phase of its life-cycle. Such a result would almost conclusively indicate the kingdom to which it belongs, but the deterring factor is, of course, the risk to human life."

Filariasis and Trypanosome Diseases: Henry B. Ward.

The presence of microscopic nematodes in the blood was recognized as early as 1872, though their separation into distinct species has not even yet been fully accomplished. The best known of these embryonic forms is that belonging to *Filaria bancrofti;* it was shown by Manson to manifest definite periodicity in its occurrence in the peripheral circulation, and hence was designated *Filaria nocturna.* During the day this form retires to the capillaries of the lungs. For further development it must be taken up into the stomach of a mosquito, from which it wanders out actively into the thoracic muscles and there assumes a quiescent stage. There appears to be no definite generic adaptation as in the case of the malarial and yellow fever organisms, but various species of *Culex* and *Anopheles* may serve as intermediate hosts. After a period of rest and growth covering fourteen to twenty days the larvæ become migrants and move through the lacunæ of the body into the proboscis. The precise method of transference into a new host is not yet clearly demonstrated, but the filariæ

are next found as adults coiled in lymph glands. The enormous mass of embryos produced by the females blockade locally the lymph vessels and the resulting lymph stasis leads mechanically to dilatation of the tissues and increase in the size of parts which shows itself as varicose glands, chyluria, or elephantiasis. After brief reference to other species which are only insufficiently known, reference was made to the occurrence of these forms in the western hemisphere and to their presence also in various parts of the United States. The author emphasized the need of careful studies on the anatomy of both adult and larva to enable the diagnosis of various species, and on the life history and transmitting agents to explain the spread of the parasite and the means of prevention. Attention was also called to the relations of these forms to various domestic and wild animals as facultative hosts and possible means therein of the multiplication and spread of species, while the advisability of search for the embryo forms in the blood and the need of more detailed and accurate knowledge of the pathological changes induced in the human body were noted.

After brief discussion of the morphology of the Trypanosomes their occurrence in a pathogenic rôle was discussed for the nagana, or tsetse-fly, disease of Africa, the surra of India, China and the east, the dourine of horses in the Circum-Mediterranean region, and the mal de caderas among horses on the Pampas of South America. Dutton in 1901 discovered a related species in the blood of a European who had been resident on the Gambia River in Africa, and the relative frequency of such cases together with their distribution over the territory bordering on the Gambia and Congo was noted. The same form was discovered by Castellani in 1903 in the cerebro-spinal fluid of negroes suffering from 'sleeping sickness' and gave the key to the etiology of that disease. The life history of these forms has not yet been elucidated unless the recent work of the Koch expedition to Africa has succeeded in solving it. It is reasonably clear, however, that these organisms pass through one phase in the life-cycle in the body of some transmitting agent, which is probably a blood-sucking insect. The discovery by MacNeal and Novy of a method by which such forms may be cultivated in the laboratory marks a great advance and has been successfully used to detect the presence of forms not demonstrable in preparations of the blood itself. It has not availed as yet to furnish any method of treatment for the diseases produced by the organism. The phase represented in such cultures is undoubtedly only the asexual. A brief discussion followed of related forms, such as the *Spirochæta* of the owl studied by Schaudinn, of the species present in syphilitic lesions and of the Leishman-Donovan bodies; and the importance which these observations have, though incomplete, was pointed out in indicating the life history and pathological significance of the group. The author also indicated the necessity of study to determine the intermediate hosts which subserve various parasites, to secure more perfect knowledge of normal blood, and emphasized the value of more general and precise examinations of the excreta and body fluids which would be likely to disclose the presence of other organisms of this type as yet unsuspected.

The Practical Results of Reed's Findings on Yellow Fever Transmission: J. H. WHITE.

1. For the first time since Reed, Lazear and Carroll did their great work in Cuba, the opportunity offered, in 1905, in the city of New Orleans, to demonstrate on a scale of such magnitude as must needs be impressive, the true value of that work.

2. I have no desire to underrate the work done in Havana. It was a noble accomplishment, and one that should immortalize its doers, but we must remember that the Cuban city had a population ninety-five per cent. of whom were immune, and was built upon high and dry ground, while the population of New Orleans was at least seventy-five per cent. non-immune, the city itself being a perfectly natural habitat for the mosquito.

The fight began in Havana in the early spring, against two or three cases. It began in New Orleans under the blazing sun of late July, and against hundreds of cases.

3. There were two distinct organizations in the city of New Orleans, each one having the same object in view and working in cooperation with each other. The Citizens Volunteer Ward Organizations sought to destroy all mosquitoes by the screening and oiling of cisterns, by the oiling of gutters and pools, and a desultory sulphurization of houses. This last they could only accomplish by pleading with the people to do it, and nothing like perfection in this line was ever attained at any time, the *laissez faire* of the attitude of the people in general upon this question being too well known to need comment.

4. The regular organization consisted of a central headquarters, with, at first, sixteen, and subsequently eighteen, ward headquarters, corresponding, practically, with the political geography of the city. Each of these subheadquarters was in command of a medical officer, provided with from one to six medical assistants, according to the needs of his station, and kept in touch with the central office through the medium of an officer who served as adjutant. Each subdivision had its own gangs of inspectors, screeners and fumigators, and was furnished with all necesary supplies from a purveying depot established for that purpose.

5. Upon the report of a case of fever, either suspicious or yellow, to the city board of health, the central headquarters or the ward headquarters, the information was immediately conveyed to the commanding officer of the ward concerned, and a screening gang at once started for the house, placing screens and, if need be, mosquito bars around the patient, who, if his condition permitted it, was moved into another room, his own room fumigated and he then returned thereto, the rest of the house being at once fumigated. All cracks were pasted over from the inside and all chimneys attended to at the earliest possible moment in order to prevent their becoming the hiding-place of the infected *Stegomyia*. Before the expiration of twelve days, a second fumigation was resorted to in order to be sure that no infected mosquitoes escaped.

6. Our work with its results fully justifies the assertion made by Dr. Carroll, that the best policy is to treat all cases of fever as worthy of suspicion. There is no doubt that during this fight there were thousands of unnecessary disinfections done, but it was just as necessary as any other part of the work, as long as no man can always be relied upon to make an exact diagnosis in any disease, the causative entity of which is not definitely known, hence we did not wait for definite diagnosis, but disinfected first and secured the diagnosis when we could.

7. Of course any sick persons willing to go there were removed to the emergency hospital provided for the purpose, and so carefully screened and safeguarded against mosquitoes in every way as to render the use of mosquito bars unnecessary.

In the original infected area house-to-house inspection, and, indeed, house-to-house disinfection, were kept up continuously from the latter part of July until about the first of October. All over the

city house-to-house inspections were made to some extent, and this work was largely instrumental in forcing the report of cases which, otherwise, might never have been reported and might have served as seed for a future distribution of the disease.

8. With a view to the general elimination of the mosquito, we salted 750 miles of street gutters, using some 3,000,000 pounds of rock salt to form a minimum solution of five per cent., and in so doing incidentally cut the malaria rate down to almost *nil*.

9. One of the most serious problems of yellow fever has ever been, and was this year, that of transportation. In order to satisfy public clamor, we disinfected cars, both passenger and freight. We relayed passenger coaches and cut out Pullman traffic, so far as direct entry into the city was concerned.

10. I am strongly of the opinion that most of this car disinfection and relaying was unnecessary, and in support of that view I wish to call attention to the fact that, having an abiding faith in the ideas which I shall hereafter state, I purposely omitted any relay or disinfection of the Louisville & Nashville coaches out of New Orleans, going to the Alabama state line, where they were relayed. These coaches went from the city of New Orleans, traversing the entire width of eastern Louisiana and southern Mississippi, a distance of 116 miles, every day and every night, without any precautions whatever being taken until some weeks after the beginning of the outbreak, and then the windows were screened.

These cars were boarded by Mississippi National Guardsmen who served as quarantine guards, and who traveled *in the cars* with the passengers, from the western to the eastern border of the state of Mississippi and back again, day and night, in dry and in humid weather, for the whole period during which yellow fever existed in New Orleans. There were some score of them so exposed to any infection which might have existed in these coaches, but not a single one of those men so acting as train inspectors, nor any of the train crews, was taken sick with any kind of fever whatsoever, and I wish, in concluding this particular portion of my remarks, to accentuate the fact that these coaches traveled up and down Elysian Fields street in the city of New Orleans, on both sides of which street the infection was rampant, as well as up and down the river front of the city, passing the original infected area where the infection was most prevalent, thus determining, at least to my mind, as strongly as circumstantial evidence may determine anything, that the infected stegomyia does not travel to any noticeable degree; that *she remains,* as nearly as she may, at the place *where she first tastes blood,* and will not voluntarily leave a house, much less cross a street.

11. The case in which she can not find food, water and seclusion in the habitat she chooses at her birth is rare indeed, and finding these, she needs no more.

She can not abide the glare of a midday sun, as shown by Berry, of the Public Health and Marine Hospital Service, who found this species killed by two minutes' exposure to a noon sun, in Texas, in 1903.

We must not attempt to reason from analogy with other species, and be led into error because others do travel. The *Stegomyia* is a domesticated species and may be justly likened to the quiet German peasant, while the *Culex solicitans,* like a wandering Bedouin, rises from her native marsh and willingly drifts with the wind. Unlike the *Stegomyia,* she has no home and wants none. She is not choice as to her meal of blood—any old hide will answer the purpose.

The rarity with which the stegomyia

migrates has been indicated many times by the frequency with which houses so close to the infected dwelling as to be almost contiguous, have escaped infection. It is further illustrated along the same lines as those I have already mentioned in regard to railroad cars, by the fact that in each case in which we have been able to trace the manner of infection in a city or town, it has been found that the locality was infected by some person who, arriving there during the incubative period of the disease, subsequently developed the fever. In no instance has there been any legitimate evidence which would point to any other method of infection.

I believe the idea prevailing among some people with regard to the traveling of the infected mosquito, to be a bugaboo, though I do not desire to be understood as saying that the stegomyia never does travel. It unquestionably does, but only because in the incipiency of its life it has taken up its habitat in a car instead of a house, or because accidentally imprisoned in a box or a drawer, it is carried, *nolens volens*, but rare, indeed, are such cases.

I have been quoted by Dr. Rosenau, in his work on disinfection and disinfectants, as saying that 'disease more often crosses the street in a pair of shoes than in any other way.' It was to yellow fever that I alluded in our conversation about this in 1898.

12. So confident were we of the absolute truth of the mosquito law, that right from the beginning we brought yellow fever patients from points outside of the city, and placed them in the hospital here, believing that in so doing we ran no risk of increasing the infection. We allowed people from infected points in the state, such as Patterson and Tallulah, and from the infected localities of Mississippi, to come into this city with no other precaution than that they should be provided with a certificate that they were not from an actually infected house and were in good health when they started. We had no trouble whatever on this score, and to the credit of American manhood and womanhood be it said, the addresses given by these people as their intended residences in the city were absolutely and invariably correct, and all of them were inspected, without difficulty, during the first six days of their sojourn here. The only trouble we had from incoming persons was occasioned by those who sneaked in from contiguous localities, and consequently evaded the daily inspection, as they had already ignored the requirement that none who came from an actually infected house should be admitted.

13. Yellow fever is so easy of control, if only the medical profession and the people will be frank and honest with the health officers, that it seems a crime against humanity that we must needs quarantine such a disease. There is no more rationalism in quarantining yellow fever than there would be in quarantining typhoid. Indeed, there is less, because it may be stated as an absolute and invariable law, that a case of yellow fever known in the first two or three days of its existence, and to which proper measures can be applied, presents absolutely no menace to the community, nor even to the family resident in the house with it. Until, however, such laws are enacted and enforced as will make the concealment of a case of yellow fever, either through the complaisance of the family physician or the cowardice of the family, a crime and an absolute impossibility, there will continue to be more or less of quarantine—probably more. Such laws are deemed by many people an interference with individual liberty and incompatible with the rights of American citizenship, and similar buncombe, *ad libitum*. The only other alternative, and a most excellent

one, too, will be the passage and enforcement of laws insuring the proper sanitation of our cities, this being a matter which offers so many other advantages in addition to the removal of yellow fever, as to make it appear to my mind the most imperative need that confronts the south as a whole, and the really proper solution of the entire matter.

14. It would be a false claim, if set up by any of our great northern cities, that they intelligently got rid of yellow fever, for it is a fact which must be apparent to all of us, that they did nothing of the kind. They intelligently provided themselves with municipal utilities which appealed strongly to their ideas of creature comfort and general cleanliness, and which, incidentally and entirely accidentally, eliminated the mosquito at the same time. These public utilities were a thoroughly controlled water supply, sewerage, drainage and pavements, and these four, not one, but all of them, were essential to the end attained.

We may rid the city of New Orleans of yellow fever, but we shall never rid it of its susceptibility to that disease until these four requirements are complied with, and the possession of these public utilities will also do away with many of the other 'ills that flesh is heir to.'

It is irrational to go on, year after year, fighting only the infected mosquito, when we can, with a little more trouble, destroy all mosquitoes once and for all. To put the matter plainly to the business man who is, after all, the court of last resort, make an investment now in good health, and it will pay you enormous dividends in increased business, in reduced loss of time by yourself and your employees, and in that priceless boon that comes only to the man free from any taint of disease—the one only thing that makes our north superior to our south—the pure joy of living.

I would briefly summarize the matter thus:

1. The only true way to fight yellow fever is to wipe out all mosquitoes by water supply, sewerage, drainage and paving.

2. As a palliative measure or temporary expedient pending the first proposition:

(*a*) Compel the report of all fevers.

(*b*) Screen all fever patients.

(*c*) Use a culicidal agent in all dwellings of the sick, at once, and again before twelve days have elapsed since patient sickened.

(*d*) Authorize inspection by health officer of any patient.

Though perhaps out of place, let me pay a well-deserved tribute to the patriotism of the citizens as a whole, and to the citizens' committee, the clergy and the medical profession, and finally, to that gallant band of officers, some sixty in all, who worked in the dust and sweat of August with untiring zeal, and particularly the score who were my captains and did such duty as, had it been rendered to the first Napoleon, would have been rewarded by a marshal's baton.

Difficulties of Recognition and Prevention of Yellow Fever: QUITMAN KOHNKE.

The doctrine of the mosquito conveyance of yellow fever, for the practical application of preventive measures based thereon, may be expressed thus:

The immediate causative factor, the germ of the disease, is accessible to the only natural vehicle of infection, the mosquito, during the first three days of the fever, and the germ after entering the mosquito's stomach requires twelve days to reach one of the salivary glands, from which the insect, while feeding, may inject it into the blood stream of its victim, in whose system the period of incubation is usually from three to five days, rarely six.

The human subject of the disease may be considered infectious, therefore, to the mos-

quito during the first three days of the fever, and not thereafter; the mosquito being infectious after the twelfth day from the date of inoculation, and not before. Its victim shows the first symptom of disease usually in less than five days after infection by the insect.

The exceptions to this rule are not sufficient to suggest its modification, but in actual practise the patient is considered possibly infectious during four days, and the mosquito possibly dangerous on the tenth day.

A case of yellow fever can not occasion another case in less time than the period of incubation in the mosquito, which is twelve days, added to the period of incubation in its human victim, which is not less than three; fifteen days completing the minimum cycle of infection. We may say approximately that explosions of infection should be expected, and are observable semi-monthly, and the result of disinfection can not be determined earlier than fifteen days thereafter. We can not say how many cases may result in about two weeks from one case untreated sanitarily, but we can say positively that no case will result if there are no mosquitoes present of the *Stegomyia* variety. Conversely we may apprehend a great infection in the presence of great numbers of mosquitoes.

The application of the mosquito doctrine to the prevention of yellow fever is all that need be done in any emergency, but to accomplish this is a problem not to be solved by any set formula. It is an easy matter to set down on paper and in an office a lot of rules in the abstract to be carried out in the field, but it is a different matter to apply these rules concretely to actual cases to obtain results.

Circumstances and conditions met with in actual practise may radically change the relative value of details, esteemed of paramount importance theoretically.

As applicable to a locality or community, I wish to place before you three propositions, upon the first two of which is based the third, which is offered in the nature of a conclusion.

1. Quarantine against yellow fever can not be made absolute in its protective value.

2. Early recognition of the presence of yellow-fever infection is difficult always, and at times impossible.

3. The most dependable measure of prevention of yellow fever is destruction of the *Stegomyia fasciata* before the possibility of infection.

Extensive argument is not necessary in an assembly of this kind whose every member is qualified to do his own thinking and form his own conclusions upon the evidence presented.

Quarantine.—In quarantine against yellow fever two essentials are to be considered, and nothing else. Detention of persons exposed to infection for not less than the period of incubation of the disease, and the prevention of entrance of infected mosquitoes.

The increasing rapidity and facility of travel makes quarantine more difficult and less reliable. However near to perfection may be our own maritime quarantine system, we shall always be exposed to infection by rapid land transportation from ports not themselves infectible, or which are less careful for other reasons. Quarantine, though important and necessary, can not ever be all-sufficient.

Early Recognition.—Early recognition of yellow fever, so essential to the prompt application of sanitary remedial measures, is rarely to be expected. The history in this respect of 1897–8 and 1899, as well as that of 1905, exemplifies this, not only in New Orleans, but elsewhere, even in Havana, where better preparation is made and better opportunities offer for the prompt discovery of early cases.

We should not relax our constant watchfulness during the season of danger, but we must realize that knowledge of the existence of first cases requires a combination of factors not always obtainable and not within our practical control.

Destruction of Stegomyia.—Finally, we must, I think, conclude that the destruction of the only natural transmitting medium is the surest preventive of yellow fever. This measure also is subject, of course, to imperfect application in practise, and incomplete results. It is not sufficient, alone, to guarantee against infection, but it offers the important element of time during which to encourage its thorough application; and in the event of the failure of quarantine and of the prompt recognition of infection, the spread of the disease is modified by even a partial destruction of the conveying medium, and this gives time for perfecting organization against the infected insects.

The health authorities of this city were convinced of the truth and importance of the mosquito doctrine of yellow-fever conveyance upon its first announcement, and of the importance of mosquito destruction. Twice a law such as is now operative was proposed and rejected, and our belief is now, as it was then, that the destruction of *Stegomyia* mosquitoes prior to the introduction of yellow fever is the ounce of prevention that is better than the pound of cure.

I show three charts of mortality for three separate years, one of which, 1905, is a yellow-fever year.

The causes of death are those under which yellow fever may be concealed, intentionally or not.

A careful analysis of these records does not bear out the notion, expressed by some, that yellow fever should have been recognized earlier than the middle of July through an inspection of the mortality from these causes.

1905.

	Malaria.	Acute Nephritis.	Bright's Disease.	Enteritis Under Two Years.	Deaths Typhoid.	Cases Typhoid.
January.	0	6	60	11	11	32
February.	4	3	51	10	2	7
March.	2	7	42	7	8	16
April.	3	3	35	25	6	26
May.	5	8	48	116	6	19
June.	5	4	44	91	11	24
July.	11	6	32	38	28	114
August.	6	5	43	18	13	31
September.	2	4	27	24	5	26
October.	2	5	34	11	3	12
November.	5	8	44	14	6	16

1904.

	Malaria.	Acute Nephritis.	Bright's Disease.	Enteritis Under Two Years.	Deaths Typhoid.	Cases Typhoid.
January.	4	5	38	9	9	16
February.	3	5	40	3	7	15
March.	5	8	41	16	2	8
April.	4	7	37	80	6	18
May.	6	3	32	70	10	28
June.	5	4	42	50	13	28
July.	4	5	42	40	11	45
August.	6	6	25	22	14	58
September.	13	5	32	19	12	37
October.	9	10	47	17	10	26
November.	6	8	42	16	10	26
December.	3	5	56	12	7	31

1903.

	Malaria.	Acute Nephritis.	Bright's Disease.	Enteritis Under Two Years.	Deaths Typhoid.	Cases Typhoid.
January.	3	4	53	13	5	16
February.	1	7	53	12	4	8
March.	4	2	53	10	6	13
April.	2	5	39	20	6	13
May.	9	5	41	82	8	28
June.	11	5	30	73	18	55
July.	10	3	39	56	16	59
August.	9	3	51	26	21	79
September.	8	3	54	11	14	66
October.	11	7	51	17	8	25
November.	10	6	49	18	2	24
December.	3	5	50	17	11	26

The value of mortality charts is historic, not prophetic, in respect to yellow fever.

Investigation of individual cases, whose circumstances, together with the given cause of death, excite suspicion, is more reliable than an observance of increase in numbers, and is earlier available. This is

our routine summer practise during the danger period, and was done during the past summer with negative results.

The explosion of infection in New Orleans this year was due to an unfortunate combination of unfavorable conditions, to which was applied the spark of introduced infection. How the fever entered the city is not the official concern of the health officer, who has no function or authority in maritime or inland quarantine. When it got here, however, it found ideal factors for its development and spread. The section of the city first infected is the most densely populated, the people are for the most part ignorant of our language and illiterate in their own. Their habits are unsanitary and their customs such as tend to secretiveness and improvidence. They are not, as a rule, vicious, but fearful of police authority, and exceedingly clannish; as is not unnatural for foreigners in a strange country. Medical attention in case of illness is usually delayed until the severity of symptoms demands it, and any but severe ailments are likely to be followed by recovery without medical interference. They are attended when ill mainly by physicians of their own nationality, some of whom are unfamiliar with yellow fever. They are apt to resent the reporting of any case of communicable disease to the authorities, and are likely to dismiss the attending physician for this reason. Imagine a crowded population of this kind whose water supply consists in large part of river water, kept for settling purposes in numerous open barrels, each one an ideal breeding place for the *Stegomyia* mosquito.

For more than four years the health officer, encouraged and supported by the board of health, had pointed out the danger; had explained, urged, begged and prophesied, but other considerations were deemed of greater importance than the destruction of mosquitoes. When the disaster came, however, the people of New Orleans, awakened from a lethargic sense of security, rose to the situation and demonstrated their willingness and ability to fight the greatest battle that was ever waged against yellow fever; and they conquered. The united forces of the combined authorities of city, state and nation and the whole people of New Orleans succeeded in turning a great calamity into the most glorious victory of modern times. For the first time in New Orleans an epidemic of yellow fever was fought with the weapons suggested by the doctrine of mosquito conveyance of the disease, and for the first time extensive yellow fever was controlled as early as August.

The first victory over yellow fever was in Havana, the greatest in New Orleans.

The pictures exhibited show the character of the neighborhood first infected, its nearness to the landing place of the Havana steamers (I do not claim, however, that our infection came from Havana) and the facility with which infection could have gotten, and probably did get, to the luggers, the landing place for which is in close proximity; these luggers being connecting links with the gulf coast of Louisiana.

Suspicion was directed to this neighborhood of the city about the middle of July, but subsequent knowledge indicated the real beginning of yellow fever infection to have been probably several weeks earlier. At no time in the history of New Orleans did an epidemic of yellow fever begin to decrease as early as did the latest and we hope and believe the last one.

Never before was an epidemic of yellow fever in New Orleans fought in the same way, and the most skeptical of reasonable persons must conclude that the control of what would have been one of the greatest of yellow-fever epidemics was due solely to the prevention and destruction of mosquitoes.

Dr. James Carroll said in discussing Dr. Kohnke's paper: "The chart by which Dr. Kohnke shows that there was a marked increase in the death rates from pernicious malaria and acute nephritis in New Orleans during the months of May and June, 1905, proves conclusively to my mind that fatal cases of yellow fever occurred in the city during those months and that the disease was probably also present during the month of April. They recall forcibly to my mind an incident that occurred at Pinar del Rio, Cuba, in 1900. During a localized outbreak of yellow fever a number of deaths took place and though some post mortem examinations were made the cases were diagnosed 'pernicious malaria with acute nephritis.' The unusual mortality rate attracted attention and upon investigation it was found that the disease prevailing was yellow fever. As the records of innumerable epidemics show that where yellow fever is wrongly diagnosed it is usually regarded as pernicious malarial or bilious remittent fever, and as death from yellow fever is usually accompanied by acute nephritis or parenchymatous degeneration of the kidneys, the explanation suggested is probably the correct one. This opinion is borne out by the record for July and the following months during which the excessive number of deaths from pernicious malaria and acute nephritis no longer appears, seemingly for the reason that yellow fever was declared in the month of July."

The Practical Side of Mosquito Extermination: HENRY CLAY WEEKS. (Presented by A. C. Eustis.)

In essaying to speak on such a theme before a body of scientists, it must not be understood that the purely scientific side is to be subordinated or is imagined to be of less importance than the practical. On the reverse, the methods under which practical work has been most successful are based entirely on the scientific work of the entomologists. It is through their patient labor that others have been encouraged to carry into practise their findings to their legitimate results. The scientific work of the bacteriologists too has given great strength to the demand for practical work.

Without diminishing their share in the movement it may be truly said, however, that entomologists have always known the fact that the mosquito must have water in which to develop from the larval and pupal stages to the adult. But, as is very generally the case, these students have been, in former years at least, engrossed with the study of the life, habits and structure of these pests and did not carry, and indeed were formerly hardly expected to carry, the knowledge gained into the practical realms of extermination. They may be said to have been working at too close a range to see all the results which their knowledge implied. There was needed the more general survey over the entire subject by practical minds of persons, who knew, perhaps, only the basal facts about these pests, to bring about a great reform. Just as in the case of some one who confines his attention closely to his line of business, another in a different line will see opportunities of extension and profit which his closeness of application precludes. Thus there has grown up a profession of men who go from one business house to another more thoroughly practicalizing businesses of which they before knew little or nothing.

In this case, exceptionally, the suggestion of relief came from Dr. L. O. Howard, who combined both the student and the practical mind, and by his experiments and announcements brought hope that practical extermination on a wide scale was possible. And when Dr. Howard saw that there was

even a broader and more radical relief possible than the use of oil (which idea he discovered to be of great practical though limited results) he was the first to encourage the broader idea of drainage when he observed this plan urged in the scientific press, as it was nearly seven years ago, and it was he who gave the necessary inspiration and encouragement to practical men who were interested. The death knell of the mosquito then began to sound when Dr. Howard inspired the carrying into effect of known resources of destruction. To use a bull, some concluded that the best of extermination methods was to destroy the mosquito before he was born and he endorsed the idea.

The world has moved toward practicalizing scientific knowledge rapidly in the last few years and this matter thus early fell into line. The mind of the entomologist who forcefully recommended the larger use of oil as a remedy was simply going a step beyond his real field and applying his knowledge to practical uses—which should be the object of all scientific study and not the thing *per se*. And then this line of thought inspired the idea that if oil was good in a limited way why not go further, and to the root of the matter, and destroy the breeding places. The seed-thought, however, had been dropped some time before when a casual remark had been made that a certain place, before experienced by this speaker as unendurable, had been cleared of mosquitoes by a piece of commercial drainage, but it was the work of the entomologist, as before stated, to nurture the idea to fruitage.

So when plain, practical men, who knew little of entomology, saw that water was needed to develop the pest, they were just so practical, or unpractical, if you please—such visionaries—as to say, let us do away with all water in inhabited sections where the pests breed. They simply put two and two together while heretofore these factors had been widely separated. And so widely and so long were they apart, that when the union was proposed the world laughed aloud, and a few of a certain caliber of mind are laughing yet.

There has been many a great idea retarded for ages because of this spirit of ridicule, and many a man has gone down under such opposition who had a thought which, if encouraged, would have blessed mankind ages before its final acceptance. We can all think of instances of this. Insistency often has been lacking.

But, fortunately, the mosquito cranks were as persistent as the pests themselves. They kept at the subject until they reversed the universal practise and they themselves began to draw blood. And so, probably, no crusade, which at first seemed so chimerical, ever made such strides as has the mosquito crusade, in the last three years or so, until now, that which less than a score of years ago began as an oiling experiment in a summer resort in the Catskills has spread to a crusade of drainage, filling and the like; and oil, which is indispensable in certain limited conditions, is now largely supplemented by extensive engineering operations. Now, engineers of national reputation are applying to their work the solid foundation laid by scientists and urging broad remedies upon communities and cities which have been sadly injured by the mosquito nuisance.

In a report (1903) on the improvement of a river in New England, an engineer, whose abilities have brought him into large projects in many sections of the country, makes the mosquito, and hence the malaria question, one of the moving causes for a proposed improvement. He calls to his aid a Harvard pathologist of world-wide

reputation who devotes many pages of this report to the mosquito question.

And in 1904, the same engineer reports on the improvement of another river, and gives prime attention to the results of investigations by the scientific experts from the Massachusetts Institute of Technology. Based on their reports, he is led to state:

> The results of this inquiry were startling. Every physician who was consulted testified that malarial disease was already prevalent and that it was apparently increasing and slowly extending.

He says:

> I was thus obliged at the outset to face a great sanitary problem which for the time overshadowed the other studies, for questions of public health are paramount and should have precedence over landscape design and facilities for brick-making or maket gardening.

We may interject just here, that when health and all improvements go together, as can be planned, then is the greatest good accomplished. The experts speak of 700 acres of a fresh pond marsh section (300 of which are constantly wet and soggy) where 'physicians report that every person in every house has had the fever,' and many of them state that this is 'the most dangerous section in twenty-five miles.' While the poor who live in this swampy territory were mostly affected, the report shows the disease spreading into the best districts where it is hilly.

These lines of investigation and the results are in exact conformity to the work done and reported upon by the North Shore Improvement Association of Long Island, some years previously. And it is most encouraging that engineering works are now being undertaken with such a strong appreciation of the importance of the mosquito question.

Landscape architects are seeking informing literature and are studying the subject and discovering that their profession also can materially aid the crusade and are recommending plans with a view to this question.

These two professions have been sadly blind to their opportunities for good. Not only has their work been simply negative—that was bad enough with their opportunities—but they have actually aided breeding in most cases. Within a few days the speaker has interested an owner in a badly infested home-site who has been spending thousands of dollars in following the plans of eminent landscape architects as to the lay-out of the wide lawns in front of his dwelling, while just in the woods behind there has existed for ages and still exists a breeding place extensive enough to ruin the pleasure which his home should yield him; and a surplus of pests to curse his neighbors. Now, this man is moving vigorously to get rid of this pest place, not that it has not been known heretofore that mosquitoes would breed in such places, but solely because it has been demonstrated that such work is entirely practical and certainly is highly desirable for comfort, for health, for increase in the value of his property and in the vast improvement to scenic effects. This is simply a case of neglecting a grand opportunity, but when these professions actually produce breeding grounds, their acts become a positive wrong to the public.

A gentleman of large means, recently met, has been encouraged to work on these lines on his vast property and now assures the speaker that he considers the question one of the most far-reaching before the people. This we have been endeavoring to show for nearly a decade. He feels that no money he is spending on roads and other improvements will pay him better. He also assures us that in the immediate vicinity where he has done work, which this crusade encouraged, he plainly notices a great difference in the number of pests

and he is going to continue the work with vigor for its absolutely paying results.

A little town in New England of less than a thousand inhabitants, whose chief industry is fishing, has recently become impressed with hope, founded on experiences elsewhere, that something might be done so that its thousands of acres of breeding grounds might be redeemed to agriculture, its desirable building sites relieved from the curse of mosquitoes which has always existed, and thus its lands become habitable, its taxable valuations increased, and so the town be greatly benefited. Inspired to join the crusaders, it had been working in a limited way and found excellent results, but it is now in a movement for raising and expending a large sum of public money to carry out very radical plans recommended to make these benefits assured and is asking the necessary legislative authority.

We know the case of the gentleman who bought a beautiful and extensive estate with the ban on it, that no one could live on it in July and August, but who was impressed with the anti-mosquito theory, by that same entomologist with the practical turn of mind, and went to work in good earnest and has made his large tract one without mosquitoes. His success led him naturally to wish others to be blessed likewise and he was instrumental in a campaign of greater proportions. One in this wider territory wrote the speaker within a few weeks that the success of the work was still continuing, although four summers had passed; and a person in another state has stated within a few days that he was visiting in the district in question this season and went through parts which he knew once to be infested beyond human endurance and he did not raise a mosquito. So much for the lasting effects of work thoroughly and practically executed.

But I am sure I do not need to rehearse smaller instances when all know of the transcendent achievements of Dr. Gorgas, both in Havana and in the Panama zone almost entirely as the result of practical mosquito extermination. Nor do you need to be reminded that the practical work of this kind in New Orleans, first under Dr. Kohnke and others and taken up later by the general government with all its prestige and power, through its Public Health and Marine Hospital Service under Surgeon General Wyman, with his able corps of specialists all working against the mosquito —that *this* brought about the end of the scourge of yellow fever here this season without the aid of frost and has added to the demand that this scourge and its attendant ruinous results to commerce through quarantine, be treated solely as a mosquito proposition and not as an inscrutable order of Providence. The speaker well recalls the force with which Dr. Kohnke at the second convention of the American Mosquito Extermination Society urged the necessity of screening the cisterns of New Orleans and spoke of his efforts to legally compass this. But his warning was acted on too late. He was then ahead of his time, but we are glad to say he is not now.

The demand is simply: Stop breeding mosquitoes and stop it by practical measures—no chimerical plans—nothing but what a child may comprehend. But do it thoroughly—do it so that results will last. Abolish forever the breeding places and be careful not to make new ones. Communities should put up money as they would to build a fine road—as is often the case, $10,000 a mile through a mosquito-infested section—and do it *before* building the road, and then the road, when built, can answer its full purpose of comfortable travel and traffic.

How much is the quinine bill of the country? And who can estimate, besides,

the sum of the misery and loss from malaria? Who will compute how far the loss in a yellow-fever epidemic would go to make everything safe along practical, common-sense lines? Is it not a fact that the expense of tardy work and the indirect and direct commercial losses resulting from this season's experience would easily have paid for New Orleans's exemption? How long are we to suffer these evils and pay the enormous and wretched penalty before people will rise and demand that this great crusade shall have complete course? This age is not the time to say that the work is too great. Put one year's loss and the cost of remedies, the country over, into the crusade, and it will be a paying investment financially, not to include other considerations. But again, do it thoroughly, so that you will not have to come back again in another year, or in ten years, for more money. Otherwise you have set back the cause for years. Note the radical work which the general government is doing in Panama and which it considers as necessary in every way before work is fully put under way. We said a year ago that the government could well spend a million dollars to make the zone safe. That has been spent already and results will justify the outlay and many times as much more. Chairman Shonts, of the Isthmian Commission, in an address last month, expressed the well-grounded hope that yellow fever, that supreme terror of the tropics, was extirpated—never to return again to Panama. Can one conceive all that such a statement means in relation to the cost and humanity of this great work?

Assistant Surgeon General Gorgas, in his report dated November 9, 1905, just to hand, reports that of the 22,000 employees during October, of which 4,000 were non-immunes, there was but one case of yellow fever and no deaths. He pertinently contrasts conditions for the same month in the zone now and under the French régime before the mosquito theory was known. Then there were reported 21 deaths and 84 cases, and many of each were not reported. Now he has care of one third more non-immunes and there is only one case. He maintains 'the results are solely and entirely due to the sanitary measures put in force.' He has an anopheles brigade reporting thousands of feet of ditches dug and cleared and other remedial work; and a stegomyia brigade reporting and remedying tanks, cisterns, barrels and other breeding places. To overcome the dangers from these pests which get to wing, he has a fumigating brigade, reporting houses fumigated containing 12,000,000 cubic feet, using 18,000 pounds of pyrethrum and 7,800 pounds of sulphur. Dr. Gorgas finds a steady decrease in cases of yellow fever under this work, while there is a steady increase in the number of persons susceptible. He considers the sanitary question in Panama settled—that the largest necessary force of laborers can work there without suffering from yellow fever and that 'the general health can be kept as good as if they were digging a canal in the healthy part of Maryland.' Now all this you may hear stated by others, but bear in mind it is the practical side of mosquito extermination we are trying to emphasize, and this is all practical and highly profitable in every way and bears well to be repeated. Also recognize that to some extent such work is necessary in many communities in the states and that it is just as profitable here in a humanitarian view as a financial proposition and in other aspects.

No progressive man will object that the general government is spending hundreds of millions on good roads, on irrigation, on river and harbor improvement; that the Empire State votes 150 millions for good roads and canals; but when it is considered that in some of these cases the benefit will

come only to sparsely settled sections and result in aiding comparatively limited areas and valuations, the thought arises, why should not some of these vast sums be used in blessing the country by driving out the mosquito and malaria and yellow fever, bettering the condition of the less favored people—for they suffer most—changing marsh and swamp areas into places of fertility, beauty and oftentimes into places of pleasant habitation? When it is considered that such work is largely needed in close centers of population where thousands will be benefited instead of scores, and where resultant increase of tax valuations will shortly entirely repay cost, the urgency of the subject as a public work is manifest. This body and all others working for the general good should state and reiterate this position until we get public action.

It has taken some years to get strength enough in the idea to obtain appropriations, but these are now coming in many places. Numbers of cities and communities are awakening and acting. The Department of Health of the city of New York has been expending this season in one borough —Richmond—an appropriation of $17,000 under Dr. A. H. Doty, the health officer of the port, and it is to be hoped the results will encourage work in other boroughs. But all public work particularly, we repeat, should be done most thoroughly or the press and people will raise such opposition as to cause a set-back in the practical work of a thoroughly scientific problem.

The city of New York is also helpfully acting in the reform by utilizing part of its inorganic waste in filling in breeding places instead of carrying it out to sea and dumping it so that much floats back on to adjacent shores. In the southern part of the borough of Brooklyn, Coney Island Creek is being filled in, which, guardedly done, will prevent its waters from saturating hundreds of acres of marsh land where mosquitoes are now famous. This evil and this benefit were pointed out some seasons ago when a crusade was initiated there by the late Mr. Wm. C. Whitney.

Some two or three years ago we were greatly encouraged in learning that the Italian government had made a contract with some German capitalists to drain the great marshes about Rome—to destroy the breeding places of mosquitoes and thus render the section healthy and inhabitable. But it seems that this great improvement and blessing to a race has been kept back until now by the obstruction of a few sporting noblemen (in title) who wished to have the marshes left for their personal pleasure. Now the press informs us the work is to go forward and the promoters are to be paid in hitherto worthless land. What a suggestion for our country along lines of marsh improvement and the obstruction met from personal interests of a few seek pleasure or profit.

The great benefits of mosquito extermination we feel, are to be accomplished by a careful education of the public mind and a judicious effort for laws and public appropriations, by cooperation of general and state governments, of cities and rural sections, of individuals and public men in a short, strenuous campaign. What need of taking decades in these moving times? And it is on these lines that the American Mosquito Extermination Society is earnestly working, and I bespeak for it your influence and cooperation.

It would take too much of your time to speak of this phase—the basal work, education—education of the public school children of the country, the lawmakers, the editors and press writers, the civic organizations, the professions interested, the great mass of the people. But this work our society is striving to do and has its members distributed well over America, to whom our literature is scattered, and we

frequently hear of its bearing good fruit in campaigns. In our society, either as officers or on the advisory boards, are many men of broad influence in the country. Among these the earliest to go into the movement, inspired by the entomologist before referred to, were Matheson, Kerr, Miller, Hoyt, Cravath, Rand and Wetmore —business men of largest affairs.

We have got such men together, with many others known over the world, into a society, which, according to its constitution, seeks 'to unite in a general body, persons believing in the various great evils resulting from the unrestrained breeding of mosquitoes in civilized sections, and in the practicability of their extermination therefrom, by private and public systematic operations.'

For these worthy objects we ask your active cooperation with us and in closing thank you for your attention.

(To be continued.)

SCIENTIFIC BOOKS.

The Analytical Theory of Light. By JAMES WALKER. New York, The Macmillan Company. Pp. xv + 412. $5 net.

The Electromagnetic Theory of Light. By CHARLES EMERSON CURRY. New York, The Macmillan Company. Part I. Pp. xv + 400.

Walker's 'Analytical Theory of Light' is, perhaps, the most complete treatment of the subject so far attempted from the standpoint of the general wave theory, without any special assumption as to the character of the waves or the nature of the transmitting medium. With this restriction in mind, it is not surprising to find relatively much more space given to the older and more worked-over parts of the subject, such as interference, diffraction, isotropic and crystalline reflection and refraction and the interference of polarized light, as contrasted with absorption, dispersion and magneto-optics, those portions which at present seem more fruitful of interesting and important results. While the book is built on a rigorous analytical framework, nevertheless frequent comparison with experimental facts, and more sparing application of theory to instrumental methods keep the reader in touch with the physical side of the subject—to which end numerous references to the literature of the various special fields also assist. The book is written in a clear and attractive style, and its value as a reference work is increased by an index as well as by appendices dealing with the properties of Bessel's, Struve's and Lommel's functions.

It is in one sense hardly fair to criticize a book because it is too exactly what its author intended it to be; at least one should, while questioning his judgment, commend his pertinacity of purpose. This applies to the second of the above books, Part I. of Curry's 'Electromagnetic Theory of Light,' in which, as is stated in the preface, 'empirical facts' are referred to 'only where a comparison with theoretical results seemed of interest.' One must regret that so few cases 'seemed of interest'—for the result is a book unnecessarily abstract, which, while entirely modern in treatment, and sufficiently cognizant of recent theoretical discussions, is out of touch with the experimental side of the science. While this general method of treatment has been most successfully applied to the more finished science of mechanics, it hardly seems at present the best for the less developed field of optics. This point of view is, perhaps, responsible for one or two rather amusing misstatements, as for instance (p. 13) that the varying sensibility of the eye to different wave-lengths, follows because the usual expression for the intensity of a ray of light

$$\left(I = \frac{m\pi^2\nu^2a^2}{\lambda^2}\right)$$

contains the wave-length.

The treatment is throughout based on the electro-magnetic theory of Maxwell, but a very considerable amount of space is given to the discussion of 'primary' and 'secondary' waves, the exact definition of which and their special treatment is due to the author. Aside from this the ground covered is about the same as in the earlier chapters of Walker's treatise, with, however, emphasis laid on dif-

ferent points. Besides the introductory chapters there are the following headings: General Polarized Oscillations, Interference, Huyghen's Principle, Diffraction, Reflection and Refraction at Isotropic Media, and Propagation of Waves through Crystalline Media. In accordance with the general plan mentioned above, no application of theory to instrumental methods is anywhere given. The large amount of ground left for the second part will, if covered in the same detail, make the treatise as a whole the most ambitious and extensive available in English; and while one can not but admire the power and generality of treatment, to the present reviewer, at least, the book seems greatly handicapped by the attitude already referred to and by a certain rather formidable style.

C. E. M.

Madison, Wis.,
February, 1906.

Catalogue of the Crosby Brown Collection of Musical Instruments of all Nations. IV., Historical Groups. Gallery 39. New York, The Metropolitan Museum of Art. 1905. Pp. xvii + 168; pl. 12, partly folded.

Earlier parts of the catalogue of this rich collection have been reviewed in Science. The present volume deals with a fifth gallery opened to the public in 1903. The exhibits in it include: (1) a number of prehistoric instruments, originals or copies; (2) a dozen plaster casts of ancient sculptures showing musical instruments; (3) about 230 drawings of instruments used from the earliest times to the thirteenth century A.D., grouped by types and countries to the east or west of Assyria and Egypt; (4) the leading European instruments with their kindred forms in different countries; (5) details of the construction of the violin, flute, cornet, piano and organ; (6) some keyboard instruments, in part recently acquired, showing especially the development of the piano and several of the earliest American pianos.

The mere enumeration of these groups shows that a new stage has been reached in the history of the great collection. Begun merely with the purpose of decorating a music room, it soon outgrew private walls and came to include nearly every existing kind of instrument that could be obtained. These were classified, catalogued and described. But the collection lacked specimens of the almost unobtainable instruments of ancient and prehistoric times. This gap is now at least partly filled by the many reproductions and drawings. These latter are of great variety, value and interest; the list of books from which figures are copied is a long one; but too many of the 'authorities' get their illustrations at second-hand instead of first-hand, and copies are rarely accurate; the addition or omission of a line by a draftsman who does not thoroughly understand the instrument not infrequently makes the figure unintelligible or misleading. It is unfortunate that the most easily accessible references are the voluminous and rather antiquated books by the uncritical Carl Engel.

A peculiarly interesting feature is the collection of partly-finished instruments of the five kinds named above, with the tools and specimens of materials used in their manufacture; all the parts are carefully named and the exhibit is accompanied by technical descriptions. All this recalls the remarkably full and accurate descriptions of all arts and industries in the great French Encyclopédie before the Revolution. The models of a tubular pneumatic and an electro-pneumatic action for organs are very perfect and illustrative.

This volume impresses the reader as marking an advance over the earlier ones; there was here opportunity for a more comprehensive grouping of instruments illustrating the long story of musical development, and the opportunity has been well used; therefore, much of the book is as useful to the reader anywhere as to the visitor. The copious bibliography and several full indexes are noteworthy. Acknowledgments are again made to Mr. Galpin, of England, and for the first time to Miss Fannie Morris, who has done a large part of the work on all the catalogues.

This series of catalogues being now, we believe, completed, one looks forward with interest to see in what way the collection will be utilized by the donor, the authorities or

independent students for the advancement of knowledge and the sympathetic study of man's instruments of musical expression. It is already clear that the problems are not so simple as would appear from the ordinary presentation of Helmholtz's theories; for the materials accumulated in the forty years since he wrote require an ampler framework.

CHARLES KARSON WEAD.

SCIENTIFIC JOURNALS AND ARTICLES.

THE February number (volume 12, number 5) of the *Bulletin of the American Mathematical Society* contains the following articles: Report of the Twelfth Annual Meeting of the American Mathematical Society, by F. N. Cole; 'Note on Certain Groups of Transformations of the Plane into Itself,' by Peter Field; Report of the Meran Meeting of the Deutsche Mathematiker-Vereinigung, by E. A. Miller and Elijah Swift; 'The Present and the Future of Mathematical Physics,' by Henri Poincaré (translated by J. W. Young); Shorter Notices (Königsberger's Jacobi Festschrift, by James Pierpont; Schlömilch's Uebungsbuch zum Studium der höheren Analysis, by James Pierpont; Hedrick-Goursat's Course in Mathematical Analysis, by Wm. F. Osgood; Willis's Elementary Modern Geometry, Part I., by Virgil Snyder; Classen's Zwölf Vorlesungen über die Natur des Lichtes, by E. B. Wilson); Notes; New Publications.

The March number of the *Bulletin* contains: Report of the December Meeting of the Chicago Section of the American Mathematical Society, by T. F. Holgate; 'The Groups Containing Thirteen Operators of Order Two,' by G. A. Miller; Review of Huntington's Types of Serial Order, by Oswald Veblen; Review of Fine's College Algebra, by E. V. Huntington; Review of Freund's Translation of Ball's History of Mathematics, by D. E. Smith; Shorter Notices (Abhandlungen zur Geschichte der mathematischen Wissenschaften, by D. E. Smith; Bucherer's Elemente der Vektor-Analysis, by E. B. Wilson; Annuaire du Bureau des Longitudes pour l'An 1906, by E. W. Brown; Jordan's Astronomical and Historical Chronology, by E. W. Brown); Notes; New Publications.

The Museums Journal of Great Britain for January has for its leading article a paper on 'The Relation of Provincial Museums to Local Institutions,' by John Minto. While the subject is one that appeals to foreign museums rather than to those of this country, yet the article itself is a most excellent essay on the objects of museums and fairly teems with good things. Most museum officials will appreciate such sayings as "Most of our museums, I regret to say, are lamentably deficient in storage accommodation." "Each group of objects (in a teaching collection) should have in view the teaching of some definite lesson." "There are many instances of museums which, having secured the services of local enthusiasts for a period of years * * * have on the severance of the connection fallen upon evil days," and (this should be in large type) "It will take years to do away with the idea of museums still entertained by many * * *, as storehouses of curiosities. * * *" The many notes show that, aside from the Manchester Museum, there seems to be a liberal and growing support of such institutions in England. As for the Manchester Museum, those who know the extent and high standard of its work will be surprised to learn from its report the mere pittance that it receives for its support. In discussing Dr. Holland's recent article on 'Museums and Outside Experts,' the comment is made: "Needless to say, all type-specimens should invariably be returned to the museum, but it is usual to allow the expert to retain a selection of duplicate specimens. In our opinion, however, nothing should be handed over to the expert until all the material has been returned by him to the museum."

A JOURNAL entitled *Annales de Paléontologie* has been established at Paris, under the editorship of M. Boule, professor in the Museum of Natural History.

SOCIETIES AND ACADEMIES.

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF GEOLOGY AND MINERALOGY.

Meeting of October 9, 1905.—In the absence of Vice-President Hovey, President J. F.

Kemp called the meeting to order in the large lecture hall of the American Museum of Natural History and presented the speaker of the evening, Professor R. T. Hill, who gave an illustrated lecture on the Republic of Mexico, its physical and economical aspects.

Meeting of November 6, 1905.—Vice-President Hovey presiding.

Professor J. F. Kemp read a paper on 'An Interesting Discovery of Human Implements in an Abandoned River Channel in Southern Oregon,' which will be printed in SCIENCE.

Professor J. J. Stevenson, under the title of 'A Bit of Quaternary Geology,' described a small area in northwestern Vermont. His conclusions were that after withdrawal of the ice, clay was deposited along the streams to an altitude of about 750 feet above tide; that upon this sand, gravel and boulders accumulated to a thickness of about 450 feet. He traced the steps in reerosion of the channel ways as shown by the successive terraces. The area in question is the northward extension of Professor C. H. Hitchcock's third basin of Winooski River as defined in the 'Geology of Vermont.'

The third paper of the evening was by Dr. A. A. Julien, 'Notes on Glaciation of Manhattan Island.' The evidences of plucking action of the continental glacier upon the crystalline schists of the island consist partly of jagged broken surfaces beneath the till, with angular transported blocks in the moraine to the southeast; and partly of rounded but roughened hummocks, pitted apparently by a modification of semilunar cavities, such as have been discovered in perfect condition on scored surfaces of our limestone.

Channels and pipe-like troughs were also described and attributed to the action of subglacial running waters, probably once connected with waterfalls through crevasses in the great glacier. The allied feature of potholes, found just beyond the limits of the island, was then discussed, and another hypothesis advanced to account for their formation.

A sudden southward change in the direction of the glacial furrows over the island, their asymmetric form, and distinct southward curvature, were described as evidences of a decided slope of the general surface toward the south-southwest, at the time of its subsidence during the glacial movement. A topographical modification was also referred to, through the undercutting of joint planes facing the northeast.

Dr. George F. Kunz stated that during the spring of 1905 there had been shown to him some precious garnet, pyrope, in rounded irregular grains, transparent, measuring from two to five millimeters in diameter. That these had been found in the tunnel extension of the New York subway, about 1,200 feet south of Pier No. 1, North River, under New York harbor, at a depth of 110 feet below the bed of the bay. That upon visiting the locality he found that the entire walls of the tunnel had been covered with the iron arches, and it was impossible to see the rocks themselves, but that upon the dump heap he found a number of masses of serpentine weighing from two to one hundred pounds each. The serpentine was a rich yellow, a trifle darker than that found at Montville, N. J. Cleavages of feldspar nearly a foot long, black tourmaline, almandite, garnet in grains and in crystals were noted, but no peridotite itself was seen. This was probably due to the fact that nearly all the material taken from the tunnel was removed by barges to the deep ocean and dumped. Dr. Kunz stated that it was most unfortunate that what was undoubtedly the evidence of a peridotite dike upon New York island should have been lost. A mass of the gneissoid wall, measuring six feet by ten and nearly covered by rich stilbite was noted. Mr. C. Wotherspoon, the engineer in charge of the night work, was most courteous in giving information and in collecting specimens.

Meeting of December 4, 1905.—Vice-President Hovey in the chair.

Dr. Kunz reported the death of Dr. Augustus C. Hamlin, of Bangor, Me. Voted that a committee be appointed to make a minute of Dr. Hamlin's death. Dr. Kunz appointed.

Dr. Geo. F. Kunz described the Modoc meteorite that detonated over Modoc, Scott County, Kansas, at 9:30 P. M., September 2,

1905. First a very sharp, loud report was heard, then followed a rumbling for thirty seconds, when a shower of over a dozen stones fell, weighing from one ounce to twelve pounds each. The stone is an almost white pulverulent mass with minute specks of native iron or troilite, with occasional white glassy cleavable feldspar inclusions.

Mr. J. Howard Wilson discussed 'Notes on the Glacial Geology of Nantucket and Cape Cod.' Mr. Wilson outlined the various retreatal phases of the Nantucket and Long Island glacial lobes, and discussed the history of Glacial Cape Cod Lake, in which were built the sand plains of Truro, Wellfleet and Eastham. The paper was illustrated by lantern views and maps.

The last paper was by Mr. Thomas T. Read, entitled, 'Gold Mining in the Southern Appalachians.' Mr. Read first pointed out that this region was one of the first to which the search for gold was directed after the discovery of the new world. After tracing the early development up to the present, the geologic structure of the region and the methods of occurrence of the ore were described. After touching on the methods of working and the present state of the industry a few remarks were made as to the probable future worth of the deposits.

A. W. GRABAU,
Secretary.

THE CHEMICAL SOCIETY OF WASHINGTON.

THE 164th regular meeting of the society was held on February 8, 1906.

Mr. L. S. Munson, of the Contracts Laboratory, U. S. Department of Agriculture, read a paper on 'Writing Inks,' giving in detail the results of work recently done by himself on thirty kinds of ink. Twenty-seven of these were iron-tannic (or gallic) acid inks, the remainder being logwood-bichromate inks. They were classed as writing, copying and combined copying and writing inks. They were tested by exposing to sunlight, and by treating with hypochlorites, alcohol, water, etc., stripes made upon white paper, so as to get an idea of their relative permanence. Only one third of the samples were found to be satisfactory for record inks, and the copies made from most of them were even less permanent, owing to the small amount of iron tannate taken up by the copying paper.

A paper on 'Typewriter Ribbons,' by Miss A. M. Doyle, of the same laboratory, was also presented. Forty-three kinds of ribbons, both new and worn-out, as well as of different colors, were studied. Tests were made of the ribbon fabric and of the ink itself, and the ribbons were rated according to the original writing, copies made from it, and their permanence when exposed to sunlight and the action of reagents. Inks containing the most lampblack are most permanent, though they give poor copies, as this is insoluble. The aniline dyes present soon fade. Variations in the excellence of the writing depend largely upon variations in the fabric.

Mr. F. C. Weber, of the Bureau of Chemistry, exhibited a Zeiss immersion refractometer and explained its varied applications. It can be used for the estimation of sugars, for testing alcoholic beverages, for detecting watered milk, methyl alcohol in ethyl alcohol, etc.

Mr. Rufus F. Herrick, a visiting member, exhibited an alcohol lamp with Welsbach mantle, and, in connection with it, enumerated some of the advantages of having tax-free denaturized alcohol.

Mr. Herrick was followed by Mr. Leonard V. Goebbels, of the Otto Gas Engine Company, who told of some tests in which denaturized alcohol was used in gasoline engines. It compares favorably with gasoline, as far as cost and efficiency were concerned, and is a much cleaner fuel to handle.

Dr. Harvey W. Wiley spoke in favor of denaturized alcohol, and said that, in his opinion, the cost and risk of removing the denaturizing substances are so great that it would practically never be attempted. Besides, the obvious advantages to manufacturers are so great that there is no good reason why the bill before Congress, authorizing the sale of tax-free denaturized alcohol, should not be passed.

Dr. C. E. Waters exhibited Bishop's form

of the Marsh apparatus, slightly modified for greater convenience. The original apparatus is described in the February number of the *Journal of the American Chemical Society*. By means of an improved method of distillation and concentration, and this apparatus, Bishop detected one part of arsenic in a billion parts of sulphuric acid.

C. E. Waters,
Secretary.

THE VERMONT BOTANICAL CLUB.

The eleventh annual meeting of the Vermont Botanical Club was held at the University of Vermont, January 17 and 18. Some twenty papers were presented, including 'Recollections of the Botanical Work of Joseph Torrey,' by Miss Mary Torrey; 'The Thorn-apples of Vermont,' by W. W. Eggleston; 'The Flora of Hawaii,' by Professor G. H. Perkins; 'The Finding of *Aspidium Filix-Mas* in Vermont,' by Miss N. Darling; 'Reminiscences,' by Cyrus G. Pringle; 'Variations Among Violets,' by Ezra Brainerd.

It was decided to begin the publication of an annual bulletin of which the first number will appear this spring. The next field meeting will occur about July first on Mt. Mansfield; the next annual winter meeting at St. Johnsbury. The officers were reelected as follows:

President—Ezra Brainerd, Middlebury College.
Vice-President—C. G. Pringle, University of Vermont.
Secretary—L. R. Jones, University of Vermont.
Treasurer—Mrs. N. F. Flynn, Burlington.
Executive Committee—Dr. H. H. Swift, Mrs. E. B. Davenport, Miss I. M. Paddock.

L. R. Jones,
Secretary.

DISCUSSION AND CORRESPONDENCE.

EYE ANOMALIES.

I have recently found that my eyes are abnormal in a way which is quite new to me, and which seems to be outside of the usual group of symptoms utilized by the physicians. The effect is interesting and I venture to ask whether any reader of Science can enlighten me. Both eyes are near-sighted but free from astigmatism.

1. In the first place I see double images with each eye. A black circle, about four centimeters in diameter, regarded from a distance of six meters with one eye, appears as two circles with their centers on a line about 45 degrees to the horizontal, intersecting so that the center of one lies nearly on the circumference of the other. The images are about equally strong, naturally quite black where they intersect and there seems to be a dot at the center of each. There is some vague color. With the left eye there is a tendency to repeat this phenomenon symmetrically; *i. e.*, the circles lie with their centers at an angle of 135 degrees to the horizontal, but they are much further apart, often tangent to each other. This eye is more near-sighted. Moreover, when the eye is under the influence of belladonna (or even at other times) there may be two or more pairs of images, a strong pair at 135 degrees outside each other, and a weaker pair at about 45 degrees tangent to these; or the figures may be even more complicated. All circles have central dots. With appropriate glasses the images of both eyes become nearly clear. No explanation which has occurred to me (reflection from non-centered systems, split-lens effect, polarization) exactly meets these cases.

2. A second phenomenon which may hold the key to the preceding is the following. If at night I look at a distant electric light (100 feet off, or more) with the left eye and without glasses I see the usual patch of light of the near-sighted eye. This patch, however, is not a uniformly bright disc about one degree in angular diameter, but contains an accurately drawn circle in black of a diameter somewhat less than one third that of the disc and placed a little above the center to the right. There is no appreciable color effect or successive annuli. The circles, though scarcely visible within fifty feet, from the light naturally increase in size with the distance of the source. There is no doubt that with an appropriate Wollaston prism (departing somewhat from the ophthalmometer) they could be used for the measurement of this distance. In explanation of these phenomena it seems to me that a globule of relatively low

refractivity imbedded in the lens would come nearest. Such a bubble would replace a concave lens in front of the eye, and the rays brought more nearly to a focus would leave a deficiency around the area of convergence. Possibly the images in the preceding paragraph may be explained in the same way.

3. A third phenomenon is probably quite well known, though I must here also confess my ignorance. The diffuse and faint (false) corona which most people see around a distant point source, changes to an intensely brilliant and narrow colored ring with the blue packed close upon the red, whenever the pupil is opened by belladonna. That no true (objective) corona is in question may be proved at once by blotting out the point source with the sharp end of a pin, whereupon the phenomenon vanishes completely, although the region in which the corona was localized is still almost wholly visible. As the effect of the stimulus subsides the aperture of the red annulus, which is about 7 degrees in the brilliant and narrow state, with all colors close together, expands to about 9.5 degrees for the faint and diffuse case with the colors far apart, during the three or four days of contraction of the pupil.

The observation here in question is not lacking in interest for the physicist; yet I have often been provoked at not finding any allusion to such an obtrusive phenomenon in the treatises on optics with which I happen to be acquainted.

CARL BARUS.

BROWN UNIVERSITY,
PROVIDENCE, R. I.

PRESERVING SPIDERS' WEBS.

SPIDERS' webs are so interesting in themselves and each web is so characteristic of the particular species to which its maker belongs that their study is one of the most fascinating of natural history pursuits. However, if I am not mistaken, it is not generally known that they can be easily and permanently preserved for future study or display. One method of doing this occurred to me several years ago while watching Mr. Jas. H. Emerton spraying webs for photographing, and I have since used it so successfully that it seems worth describing.

The web to be preserved is sprayed with artist's shellac from an atomizer, in much the same way that crayon drawings are fixed, and immediately a clean glass plate is pressed against it, carefully breaking, at the same time, the supporting strands so that the web, which will stick to the glass, is freed from its former surroundings. Since every strand of the web is covered with minute droplets of shellac, they are rendered plainly visible and, furthermore, they adhere very tightly to the glass. In a short time the shellac will thoroughly dry and the plates holding the webs can be filed away in a cabinet or hung up for display. If desired, the web may be protected by covering it with another glass plate in the way that the film of a lantern slide is protected, but this is not usually necessary.

The above directions apply paticularly to the flat webs of the Epeiridæ, but with a little ingenuity almost any spider's web may be preserved in its natural form. For instance, I obtained a permanent mount of the dome-shaped web of *Linyphia marginata* in the following way: A branched twig was cut and stripped of its leaves. This was fastened in an upright position on a suitable base and several females of *L. marginata* put on it after sunset. The next morning I had a beautiful web with a perfect dome and all the outlying threads. The only thing that remained to be done was to spray it with shellac and set it away. The Theridiidæ also give very satisfactory specimens in much the same way. But for the orb webs I think the glass plates are preferable.

FRANK E. LUTZ.

STATION FOR EXPERIMENTAL EVOLUTION,
COLD SPRING HARBOR, L. I.

A NEW METEORITE FROM SCOTT COUNTY, KANSAS.

A HITHERTO unreported meteorite fall took place on the night of September 2, 1905, about 9:30 P.M., in Scott County, Kansas. The fall was attended with the usual explosion, light and sound, variously compared to cannonading and the roll of heavy wagons.

Thus far fourteen pieces of the stone have

come to light, the largest of which, weighing 4.61 kilograms, is at present in the National Museum. A broken surface shows the stone to be indistinctly chondritic, of a very light gray color, and under the microscope is found to consist essentially of olivine and enstatite, with a very small amount of plagioclase feldspar. It evidently belongs to Brezina's group of veined chondrites (Cwa), and will be known as the Scott County meteorite.

For the above information the writer is indebted to Mr. J. K. Freed, of Scott City, Kansas. This fall adds one more (the twelfth) to the remarkable list for which Kansas is becoming noted.

George P. Merrill.

THE WALTER REED MEMORIAL FUND.

To the Editor of Science: It is gratifying to note, that the executive committee of the Walter Reed Memorial Association, under the able leadership of Dr. Daniel C. Gilman, is making a final effort to raise a fund of $25,000, the income to be paid to the widow of Dr. Reed and the principal to be reserved for a permanent memorial in the city of Washington.

It may not be amiss to recall the fact that Dr. Reed's greatest achievement for science and humanity was his contribution to the cause, spread and prevention of yellow fever. The experiments which he planned and conducted in Cuba in 1901, demonstrated conclusively the causal relation of the mosquito species *Stegomyia fasciata* to yellow fever, and have given man control over that fearful scourge. The practical value of this brilliant demonstration has been proved by the complete eradication of yellow fever epidemics in Havana, New Orleans, the Gulf states, the Isthmus of Panama and wherever his teachings have been subjected to a crucial test. Competent critics are agreed that his work is the most valuable contribution to medicine and public hygiene which has ever been made in this hemisphere. The results to humanity are incalculable and as well expressed by General Wood, the military governor of Cuba:

> Hereafter it will never be possible for yellow fever to gain such headway that quarantine will exist from the mouth of the Potomac to the mouth of the Rio Grande. * * * His discovery results in the saving of more lives annually than were lost in the Cuban War and saves the commercial interests of the world a greater financial loss each year than the cost of the Cuban War.

The full significance of this statement will be apparent when we recall the fact that, according to competent authorities, yellow fever in the United States alone, from 1793–1900, prostrated not less than 500,000 persons and carried off over 100,000 victims. According to Dr. Horlbeck, of Charleston, S. C., the great epidemic of 1878 in the states of Louisiana, Mississippi and Alabama resulted in the loss of nearly 16,000 lives, and the estimated total loss to the country resulting from this epidemic was not less than $100,000,000; indeed the actual cost of the epidemic of that year to the material resources of the city of New Orleans has been estimated by Dr. Samuel Chopin at $10,752,000.

In view of the great economic importance of Dr. Reed's discovery it is somewhat surprising to learn that by far the largest number of contributors are of the medical profession, and that so far the executive committee has failed to enlist the sympathy and support of the commercial interests, especially in the Gulf states, which will be most benefited by Dr. Reed's great work. While the medical profession has erected monuments to Benjamin Rush and Samuel D. Gross, who rendered distinguished services to American medicine and surgery, it must be conceded that Dr. Reed's beneficent work deserves a broader recognition and men of science should not be expected to sustain this laudable undertaking without material aid from other sources. Dr. Reed was a native of Virginia, and it seems peculiarly fitting that his work, which affects the lives, happiness and material interests of the people of the south Atlantic states, should be appreciated by popular subscriptions. There should be no difficulty in raising the modest sum of $25,000, and the writer expresses the hope that men of science will bring the merits of the case to the attention of their friends able and willing to contribute to this noble cause. Mr. C. J. Bell,

president of the American Security and Trust Company, Washington, D. C., is the treasurer and General Calvin De Witt, 1707 21st Street, Washington, will gladly supply literature.

G. M. K.

GEORGETOWN UNIVERSITY,
February 15, 1906.

SPECIAL ARTICLES.

RESULTS OF A REPLANTATION OF THE THIGH.[1]

IT has previously been shown that a satisfactory circulation may be established in a replanted thigh.[2]

We wish here to record a summary of observations made on a similar experiment extending over a longer post-operative period.

The animal employed was a small white bitch. Through a longitudinal incision the vessels of the thigh were exposed and cut above the point of Scarpa's triangle. The skin was circularly severed and the thigh completely amputated above the junction of its lower and middle third. After a few minutes the limb was replanted. The ends of the bone, the muscles, the vessels and the sciatic nerve were united. The circulation was reestablished after having been interrupted for one and one quarter hours. The pulsations of the popliteal and 'saphenous' arteries were normal. The dark blood circulated very actively through the femoral and saphenous veins. Red blood flowed from the small arteries of the peripheral part of the cut limb. The skin was sutured and a plaster dressing applied to the limb and trunk.

After the operation the general and local conditions of the animal remained very satisfactory. It drank and ate normally and walked on its three sound limbs. The skin of the replanted foot remained normal, but its hue was redder and its temperature higher than that of the normal foot. The anterior part of the foot soon became moderately swollen.

Seven days after the operation the dressing was partially removed. The limb presented neither œdema nor trophic troubles. The œdema of the anterior part of the foot was doubtlessly due to pressure by the lower edge of the bandage, as the swelling completely disappeared within a few hours after correcting the fault of the dressing. The skin was normal and the wound had united 'per primam intentionem' without evidence of inflammation. The temperature of the skin was higher below than above the line of suturing.

Eight days after the operation the foot appeared normal in size, all œdema having disappeared.

On the tenth day, during the afternoon, the temperature of the replanted foot became lower, *i. e.*, similar to that of the normal foot. The dressing was then removed. It was found that, owing to a slipping of the plaster bandage, some urine had got into the cotton dressing and caused infection of the upper part of the longitudinal incision. A small subcutaneous abscess had developed, along the vessels. The general conditions of the animal were excellent, and the nutrition of the limb satisfactory. As the arterial pulsations were much weakened and as it was considered important to accurately determine the cause of this change, the animal was etherized and the vessels examined through cutaneous incisions, after which the animal was killed.

This dissection 'in vivo' gave the following results: The point of the vascular anastomoses was surrounded by the small subcutaneous abscess. The venous anastomosis was good. The arterial anastomosis was partially occluded by a small clot. All the other portions of the vessels appeared perfectly normal. The circulation through the limb was yet satisfactory, as the obliteration of the anastomosis was not complete. The union of the skin, the muscles and the sciatic nerve was normal. The process of consolidation of the bone was beginning. It is probable, but not certain, that if the animal had been allowed to live, the arterial stenosis would have gradually increased and that in the end the circulation would have been interrupted. Then, no doubt, gangrene of the limb would have occurred, which result would have been due

[1] From the Hull Physiological Laboratory, University of Chicago.

[2] Carrel and Guthrie, 'Complete Amputation of the Thigh with Replantation,' *The American Journal of the Medical Sciences*, February, 1906.

primarily to the secondary infection of the skin. This shows that in such experiments asepsis must be rigidly observed, not only during the operation but during all the post-operative period.

Conclusions.—(1) The circulation of a replanted limb, reestablished an hour and a quarter after interruption, by end-to-end anastomosis of the femoral artery and vein, is normal, as judged by the metabolism of the limb. (2) No trophic trouble occurs (at least during ten days). (3) Healing of the severed tissues appears to be as rapid and complete as after an ordinary surgical wound.

Alexis Carrel,
C. C. Guthrie.

Successful Transplantation of Both Kidneys from a Dog into a Bitch with Removal of Both Normal Kidneys from the Latter.

This operation was performed by our new method of *transplantation in mass,* which yields good results in the transplantation of organs. By this method the organs are permitted to retain their normal connections with a portion of their nervous apparatus, in such a manner that after transplantation their functions are soon reestablished.

A large-sized terrier was anesthetized and both kidneys and the upper part of the ureters were removed, together with their vessels, nerves, nervous ganglia, the surrounding connective tissue, the suprarenal glands, the peritoneum and the corresponding segments of the aorta and vena cava. The mass was then placed in a vessel of isotonic sodium chloride solution, and the dog killed.

A small young bitch was then anesthetized and the abdomen opened through a half circular transversal laparotomy. The aorta and vena cava were cut a little above the mouth of the ovarian vessels. The kidneys of the dog were then removed from the salt solution and put into the abdominal cavity of the bitch, and the segments of the aorta and vena cava were interposed, by biterminal transplantation, between the cut ends of the aorta and vena cava of the bitch. The circulation was reestablished, after having been interrupted for one hour and a half. The kidneys immediately became red and turgid, as after a simple transplantation, but about half an hour later the state of the circulation became normal, so that no difference could be detected between the transplanted and the normal kidneys. Clear urine flowed abundantly from the transplanted ureters, which were united to the normal ones.

Both normal kidneys were dissected and extirpated. The appearance of the transplanted and normal organs is so similar that in extirpating the latter, it is necessary to examine the pedicle in order to be certain of their identity. The operation was completed by suturing the abdominal wall and applying the dressing. Two hours after the operation the animal walked about her cage. In the afternoon she drank and urinated copiously. The following day and subsequently, up to the present time, her diet has largely consisted of meat. She drinks, eats, walks and, when permitted to, mingles with other dogs, but in the latter case she is carefully watched, as she shows a strong disposition to fight. As far as can be detected, her condition is normal. The urine has been clear throughout, showing no evidence of containing blood. The total amount appears to be somewhat increased. On the seventh and eighth days several samples were collected and analyzed, the results of which showed a slight variation in composition, but entirely within normal limits. The only abnormal constituent detected was coagulated proteid, the largest amount present in any of the samples being less than 0.25 per cent. A brief result of the analyses is given below:

Urine collected on the eighth day after the operation.

Color—pale yellow.

Odor—normal.

Reaction—slightly alkaline.

Urea—1.95 per cent.

Uric acid—trace.

Chlorides, sulphates and earthy and alkaline phosphates, normal.

Kreatinin, doubtful; indoxyl, none.

Coagulable proteid, less than 0.25 per cent.

Sugar and petone, none.

It was inconvenient to collect the total urine

for twenty-four hours, as it was deemed advisable to allow the animal to move about freely. Therefore, no exact quantitative figures for the urine per diem can be given for this period of the experiment. She will be kept as long as possible in order to continue the observations on the functions of the transplanted kidneys.

ALEXIS CARREL,
C. C. GUTHRIE.

NOTES ON ENTOMOLOGY.

AMERICAN plant lice have unfortunately been studied from the standpoint of locality, and published in non-entomological serials. Mr. Sanborn in his 'Kansas Aphides'[1] has continued this practise. This article deals only with Kansan species, but the entire title indicates that catalogue and plant-lists are to follow, we hope in the near future. Mr. Sanborn has prepared his descriptions in a most systematic and careful manner, and in many cases refrained from naming species that could not be satisfactorily determined. He has given descriptions of all the genera recorded from the United States, yet we fear that he has not studied them as carefully as demanded by the confused nature of the subject. The numerous (twenty-two) plates are good, and a great help in identification. There are several confusing mistakes in the arrangement of the text; such as *Myzus biennis*, p. 78, and *Siphocoryne avenæ*, p. 61, due to the fact that the author did not supervise the publication of his paper.

ANOTHER considerable installment of Wytsman's 'Genera Insectorum' includes some groups of particular interest to American entomologists. Pastor F. W. Konow has treated of the entire Chalastogastra or sawflies, in three fasicles, 27 on the Lydidæ, 28 on the Siricidæ, and 29 on the Tenthredinidæ. These list some 2,700 species arranged in 185 genera. The author seems unjustly inclined to lump many American species, doubtless on account of insufficient material. Fascicle 30 by H. Schouteden is on the subfamily Graphosomatinæ of the Pentatomidæ. Only a few species in three genera are from the United States, the group, as a whole, belonging to the Indo-Asiatic fauna. Fascicle 31 by H. Stichel on the Discophorinæ, a group of butterflies, contains only tropical forms. Fascicles 32 and 33 are on the Megascelidæ and Megalopidæ, small groups of the Chrysomelidæ, and under the joint authorship of M. Jacoby and H. Clavareau. The forms are mostly tropical, chiefly from South America. Fascicle 34 by Gv. Szepligeti includes a number of small sub-families of the Ichneumonidæ, from the Pharsalininæ to the Porizontinæ. Many North American species are included in his catalogue. Fascicle 35 is by J. Desneux on the Paussidæ, an old-world family of curious beetles, many of which occur in the nests of ants and termites.

LIEFERUNG No. 22 of 'Das Tierreich' treats of the Heliconidæ, a family of tropical American butterflies. It is by H. Stichel and H. Riffarth. Very properly they have refrained from dividing genera and species to the utmost limit, but have placed many forms as subspecies and varieties. While there are but 87 species, there are nearly 150 named forms. The descriptions are longer and more detailed than in earlier 'Lieferungs' of the work. Our *Heliconius charithonia* is the typical form of the species; another subspecies, *H. c. peruvianus*, occurs in northwestern South America.

M. LASS treats of the structure of the female flea.[2] He has examined especially the anatomy of several internal organs, but also writes of external morphology. He finds that the larva, pupa and adult have each ten abdominal segments, that the sex is recognizable in half-grown larvæ, that the larvæ have no eyes, and that there is no hypopharynx. He thinks they have few relations with the Diptera, and considers them a special order between Diptera and Coleoptera.

NATHAN BANKS.

[1] 'Kansas Aphididæ, with a Catalogue of North American Aphididæ, and Host-plant and Plant-host List,' *Kans. Univ. Sci. Bull.*, III., No. 1, pp. 3–82, 1905.

[2] 'Beiträge zur Kenntnis der histologisch-anatomischen Baues des weiblichen Hundeflohes (*Pulex canis* Dugès s. *Pulex serraticeps* Taschenberg),' *Zeitsch. wiss. Zool.*, LXXIX., pp. 73–131, 2 pls., 1905.

JAPANESE METEOROLOGICAL SERVICE[1] IN KOREA AND CHINA.

A GLANCE at a map of the orient will clearly show how serious and difficult a matter it is to predict weather in Japan. Japan stands under the direct influences of the Pacific Ocean and the Asiatic continent, and also of the tropical and polar ocean currents, so that meteorological as well as climatic conditions in Japan are, indeed, very complex. Very often a continental cyclone and a typhoon, which of course comes from the tropics, pass through Japan simultaneously, thus bringing complexities to the weather. On account of this, the Japanese government has felt the necessity of establishing new meteorological stations along the coasts of Korea and China.

Nine stations have been established at first, in Korea and Manchuria, and their approximate geographical coordinates are as follows:

Localities.	Latitude, N.	Longitude, E.	Height, Meters.
1. Fusan,	35° 6′	129° 3′	23
2. Mokpo,	34 41	126 4	8
3. Chemulpo,	37 29	126 37	70
4. Wonson,	39 9	127 26	3
5. Yongampo,	39 56	124 22	5
6. Tairen,	38 55	121 34	5
7. Yinkow,	40 40	122 14	3
8. Mukden,	41 48	123 23	57
9. Josin,	40 40	129 20	4

Three new stations at Port Arthur, Nikoloisk and Alexandrosk have been added to the above, and there are four others which are at the same time marine semaphore stations.

The Chemulpo Meteorological Observatory is of the first order, and the other stations are mostly of the second order and subordinate to the former. These stations make six observations daily, at 2, 6, 10 A.M., and 2, 6, 10 P.M. on one hundred and thirty-fifth meridian time (east of Greenwich). Each station is provided with a Fortin barometer, an August psychrometer, a maximum thermometer, a minimum thermometer, a Robinson anemometer with electric device, a vane, a pluviometer of two decimeters (eight inches) diameter, an atmometer of the same diameter, a Jordan heliograph or sunshine recorder, a Richard barograph, a Richard thermograph and a Richard hygrograph. The central Chemulpo Observatory possesses, in addition, an anemograph, an anemo-cinemograph, a pluviograph, a micro-seismograph, earth thermometers for different depths and a sufficient number of accessories and apparatus, such as marine chronometers, a theodolite, a sextant, photographic apparatus, etc.

The Chemulpo Meteorological Observatory and the whole meteorological service in Korea are under the direct supervision of Professor Y. Wada as the chief of the service. Ever since 1879 Professor Doctor Wada has been connected with the meteorological service in Japan, and has been for many years the chief of the service of predictions in the Central Meteorological Observatory. Japan owes a great deal to him for his important investigation of meteorological conditions in Japan and for the organization and completion of our weather service. At the beginning of the recent Russo-Japanese war Professor Wada was entrusted by the Japanese government with completing the work as the chief of that service. The Chemulpo Meteorological Observatory receives every day telegraphic reports of three meteorological observations at 6 A.M., 2 P.M. and 10 P.M. from the principal stations in Japan and from those in Korea and Manchuria, with the addition of telegrams twice a day from Tientsin, Chefoo, Zikawei, Nankin, Hangchow, Hankow, Shanshi, Amoy and Manila. Thus it will be seen that the reports abundantly suffice to enable this observatory to give weather predictions and storm warnings to semaphore stations.

The building for the observatory, constructed temporarily and opened since the beginning of the year 1905, is situated on a little hill quite near the Japanese concession at Chemulpo, at the mouth of Kanko River. Besides the observatories above mentioned, a large magneto-meteorological observatory is now planned to be established in Pekin by the

[1] For the Meteorological Service in Japan, see a short account of 'Recent Advances in Meteorology and Meteorological Service in Japan,' published in *The Popular Science Monthly*, February, 1906.

government of Japan, and also several stations in the southern part of the Chinese empire.

S. T. TAMURA.

WASHINGTON, D. C.,
January 22, 1906.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR A. A. MICHELSON, of the University of Chicago, and Professor F. Kohlrausch, of Berlin, have been elected honorary fellows of the Physical Society of London.

REAR ADMIRAL COLBY M. CHESTER, superintendent of the U. S. Naval Observatory, was placed on the retired list on February 28. He will be retained in temporary active duty in the Bureau of Navigation. Rear Admiral Chester will be succeeded in charge of the Naval Observatory by Rear Admiral Asa Walker.

THE fiftieth anniversary of the connection of Professor Frederic Ward Putnam with Harvard University has been celebrated by the presentation of a volume, handsomely bound, containing autograph greetings from forty of his former students, who are now actively engaged in scientific work, most of them in the field of anthropology. Dr. H. C. Bumpus, director of the American Museum of Natural History, has been authorized by President Jesup to offer Professor Putnam ethnological material sufficient to illustrate fully the life of the inhabitants of the Philippine Islands, leaving him to make such disposition of the collection as he may think best.

A COMMITTEE has been formed in Great Britain to celebrate the fiftieth anniversary of the discovery, by Dr. W. H. Perkin, of mauve dye, the first of the coal tar products.

WE learn from *Nature* that Sir Alexander B. W. Kennedy, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of three persons 'of distinguished eminence in science, literature, the arts, or for public services.'

PROFESSOR J. C. ARTHUR and Mr. F. D. Kern, of Purdue University, held research scholarships at the New York Botanical Garden for the month of January. Their attention was devoted to the collection of plant rusts in the cryptogamic herbarium.

A. J. COX, A.B., A.M. (Stanford), Ph.D. (Breslau), has resigned an instructorship in chemistry at Stanford University to accept the position of physical chemist in the government laboratories at Manila.

DR. J. W. BEEDE, of Indiana University, who has studied the upper Carboniferous and Permian formations from Nebraska to Texas, has been engaged to take charge of the detailed mapping of the Permian formations of Kansas next summer for the University Geological Survey of Kansas.

AMONG German men of science who have signified their intention of attending the Boston meeting of the American Medical Association are Professor Trendelenburg, Leipzig; Professor von Rosthorn, Heidelberg; Professor Dührssen, Berlin, and Professor von Frey, Würzburg.

DR. NICHOLAS SENN has been selected to deliver the oration on surgery at the International Medical Congress, Lisbon.

THE Middleton-Goldsmith lecture of the New York Pathological Society was delivered, on February 23, by Dr. Ludwig Hektoen, of the University of Chicago and the Memorial Institute for Infectious Diseases, the subject being 'Phagocytosis.'

M. L. FULLER, of the United States Geological Survey, will give a course of lectures in April at the University of Chicago on the hydrologic work of the government.

DR. GEORGE GRANT MACCURDY, of Yale University, gave a lecture on 'Prehistoric Scandinavia' before the Ethnological Society of America at the American Museum of Natural History on February 28.

The Journal of the American Medical Association states that Judge McEwen, of the Superior Court, has rendered a decision against the Chicago Medical Society in its efforts to maintain in Grant Park a boulder placed there in memory of Dr. Charles Guthrie and his pioneer work on chloroform.

ON June 29, 1903, a meeting was held at the Mansion-house, under the presidency of

the Lord Mayor, to inaugurate a memorial to the late Sir Henry Bessemer. At that meeting the following resolution was moved by the Duke of Norfolk, seconded by Professor H. M. Howe, of Columbia University, and unanimously adopted:

That this representative meeting heartily endorses the proposal to commemorate the great achievements of the late Sir Henry Bessemer, the inventor of the metallurgical process which bears his name; and it strongly affirms that such commemoration should have for its object some educational work as far-reaching in its beneficent influence as are the results of Bessemer's great invention.

The committee, with Sir William Preece as chairman, now announces that it is intended to let the memorial take the form of the establishment of memorial scholarships tenable in Great Britain or abroad, for the equipment of mining and metallurgical memorial laboratories in the Royal School of Mines at South Kensington as the center of the memorial, and for the erection of a statue of Bessemer in the Royal School of Mines. Towards the considerable sum required for the memorial the sum of £8,000 has been subscribed.

THE body of Dr. S. P. Langley, secretary of the Smithsonian Institution, was interred in the Forest Hill Cemetery, Boston, on March 3. Professor John Langley, of Cleveland, a brother, accompanied the body from Washington. An address was delivered by Dr. Alexander Graham Bell. Among the honorary pallbearers were the Hon. Richard Olney, Dr. Bell, President Charles W. Eliot, Professor E. C. Pickering and President Henry M. Pritchett.

DR. AXEL N. LUNDSTRÖM, professor of plant physiology in the University of Upsala, died on December 30.

THE following examinations are announced by the U. S. Civil Service Commission: On March 21, for the position of surveyor in the Philippine Service, at a salary of $1,400 a year, and for topographic draughtsman on the Isthmus of Panama, at $1,200; on March 28, for laboratory helper in the Department of Agriculture, at $600; on April 18, for scientific assistant in the Department of Agriculture, at salaries ranging from $800 to $1,400 a year.

A MEETING has been held at the University of Berlin in support of the establishment of a *Chemische Reichsanstalt.*

Nature states that active steps are being taken at York to ensure the success of the meeting of the British Association to be held there next August. At a large and distinguished assembly, over which the Lord Mayor of York presided, the arrangements in connection with the forthcoming visit were advanced a further stage. A reception committee representative of the city and county was elected, and it was resolved to raise a fund of not less than £2,500 for the necessary expenses of the meeting. In an appropriate speech, the Lord Mayor moved "That this meeting agrees cordially to welcome the British Association to York this year from August 1–8, and in doing so attaches special interest to the fact that the association began its existence in York seventy-five years ago." The dean of York seconded this resolution (which was carried unanimously); and in supporting it Dr. Tempest Anderson referred to local connections with the association, the first officials of which included some of the leading members of the Yorkshire Philosophical Society. The local reception committee is said to be an unusually strong one: the president is the Lord Archbishop of York; chairman, the Lord Mayor (Mr. R. H. V. Wragge); vice-chairman, Dr. Tempest Anderson; treasurer, Sir J. Sykes Rymer; and secretaries, Mr. R. Percy Dale and Mr. C. E. Elmhirst. Pro-chancellor A. G. Lupton (University of Leeds) and Professor W. M. Hicks (University of Sheffield) both spoke at the meeting, and expressed the desire of their universities to assist in making the forthcoming meeting of the association a success.

THE twenty-fourth spring lecture course at the Field Museum of Natural History, Chicago, given on Saturday afternoons at three o'clock is as follows:

March 3.—'Colors of Flowers, Fruits and Foliage,' Professor W. H. Dudley, Platteville, Wisconsin.

March 10.—'Some Aspects of Archeological Work in Central America,' Dr. Alfred M. Tozzer, Harvard University.

March 17.—'The Work of a State Geological Survey,' Professor H. Foster Bain, director, Illinois Geological Survey.

March 24.—'How People live in Congo Land,' Dr. D. W. C. Snyder, lecturer for the board of education, City of New York.

March 31.—'Love and War among Animals,' Mr. Ernest Ingersoll, New York.

April 7.—'Glaciers,' Professor N. M. Fenneman, University of Wisconsin.

April 14.—'The Seri Indians of Sonora,' Dr. W J McGee, director, St. Louis Public Museum.

April 21.—'How Plants breathe,' Professor C. R. Barnes, University of Chicago.

April 28.—'The Monuments of a Prehistoric Race,' Professor Frederic I. Monsen, San Francisco.

OFFICIAL notice has been received from the Imperial Academy of Sciences at Vienna announcing the recognition of the Wistar Institute as the central institute for interacademic brain research in the United States. Some three or four years ago, at the suggestion of Professor His (Leipzig), the International Association of Academies appointed a central commission for interacademic brain research. Among the duties of this commission was the selection of certain laboratories in various parts of the world to act as central institutes and the organization of an extensive plan for the cooperative investigation of the brain. It is in connection with this general plan that the Wistar Institute is accepted as the central institute for brain research in the United States. Recently Dr. Donaldson, Dr. Mall (Johns Hopkins Medical School) and Dr. Minot (Harvard Medical School) have been elected members of the central commission for interacademic brain research and the conduct of this work at the Wistar Institute will be under the direction of Dr. Donaldson.

IN the summer of the present year a permanent station for the study of arctic science will, as we have already noted, be established on the south coast of Disco Island in Danish West Greenland. The cost of the foundation has been defrayed by a gift from Mr. A. Holck, of Copenhagen, and the Danish government has promised an annual grant of $3,000 towards its maintenance. We learn from a letter from Dr. Morten P. Porsild, director of the laboratory, that it is equipped with appliances and instruments, especially for biological researches, and that work-places will be furnished for visiting naturalists, foreign as well as Danish. The establishment of two such places is contemplated at present. The visitors will obtain the free use of the instruments, traveling outfit and library of the station; lodging will be free and a small fee will be charged only for board. Cheap fare to and from the station, via Copenhagen, will be provided. The first visitors can be received in 1907, and notices, inviting application, will be issued in due course. A library of arctic literature is to be founded at the station and to be made as complete as possible, but in view of the limited resources of the station, only a small proportion of it can be purchased. The director will, therefore, be pleased to receive gifts of publications relating to the arctic regions and especially to arctic biology.

WE learn from the London *Times* that at a meeting of the Linnean Society of London, held on February 1 at Burlington House, Mr. J. Stanley Gardiner gave an account of the Percy Sladen trust expedition in his Majesty's ship *Sealark* to the Indian Ocean. Mr. Gardiner was leader of the expedition, which was the first to benefit by the Percy Sladen trust. Professor Herdman, F.R.S., president of the society, reminded the audience that Mr. Percy Sladen was for many years the honored zoological secretary of that society, and his widow, whose death had recently occurred, was the first of their lady fellows whom they had lost. Mrs. Sladen was the generous donor of a fund to commemorate her husband, and it was by that fund that Mr. Gardiner had been assisted in his explorations in the Indian Ocean. Mr. Gardiner then proceeded to describe, by means of maps and charts exhibited upon a screen, the region visited by his expedition, and explained the method by which they made their soundings and dredgings, many of which pro-

duced results of great interest and importance. The flora and fauna of the various islands visited were described, together with the geological formation of the rocks and the changes which are in progress. A large collection of specimens both from the land and the sea was made during the expedition, and was exhibited by the lecturer.

Nature says: "The real existence of the *n*-rays, discovered by M. Blondlot, has been the subject of much discussion, there being a general consensus of opinion outside France that the effects produced are physiological. The *Comptes rendus* for January 15 contain two papers of considerable interest on this subject. The first of these, by M. Mascart, gives details of a series of measurements of the points of maximum intensity in the spectrum produced by the refraction of the *n*-rays through an aluminium prism, by a number of independent observers. The phosphorescent screen was mounted on the carriage of a dividing engine, and each of four observers (Messrs. Blondlot, Gutton, Virtz and Mascart) made independent measurements of the points of maximum intensity. The most concordant figures were those obtained by M. Blondlot, but the general agreement of the results left no doubt as to the position of the lines. M. Mascart gives the results without comment. The second paper, by M. Gutton, is an attempt to prove the objective existence of the *n*-rays. It had been noted that if these rays are allowed to fall on the primary spark of a Hertzian oscillator, the luster of the secondary spark diminishes. This effect has been secured photographically, the difference being clearly marked in the whole of the thirty-seven experiments. The apparatus is described in detail, and the precautions necessary for success pointed out. These two papers certainly provide material for consideration by those who maintain that the whole phenomenon is a physiological illusion."

UNIVERSITY AND EDUCATIONAL NEWS.

The annual report of the treasurer of Princeton University states that $1,000,000 has been raised by the committee of fifty toward the fund to endow the new preceptorial system.

Contracts have been let for a new building at Swarthmore College, to be used for engineering shops. The building is to cost twenty thousand dollars, and is to be two stories high and will be made fireproof. In the basement the shops for forging will be located. The machine shops and metal works will be installed on the first floor, while the second floor will be given to wood working.

Old North College, a dormitory of Wesleyan University erected in 1827, was destroyed by fire on March 1. The loss, which is said to be $80,000, is covered by insurance.

Mr. Alfred Beit, of London, the South African financier, has given $500,000 to establish a university at Hamburg, where he was born in 1853.

The Association of American Universities will hold its seventh annual conference in San Francisco on March 14.

A conference of college and university presidents of New York state, and representatives of the Department of Education held a meeting in Albany last week. Preliminary steps were taken for the formation of an Association of Colleges of the State of New York, and a committee consisting of First Assistant Commissioner Rogers, as chairman; Chancellor Day, of Syracuse University; President Rhees, of Rochester University, and Dean Crane, of Cornell University, was appointed to prepare a constitution to be presented at a meeting at Columbia University, on April 19 and 20.

The New York alumni of the Johns Hopkins University held their annual dinner on March 2, the principal address being made by President Remsen. Dr. Charles Lane Poor, professor of astronomy at Columbia University, was elected president for the ensuing year.

Richard S. Lull, associate professor of zoology in the Massachusetts State Agricultural College, has been appointed assistant professor of paleontology at Yale University.